Sampling by ordinary methods gave low results, as checked by test runs made in a neighboring mill, during the exploration and development of a large low-grade gold deposit by Ora Banda United Mines, in Western Australia. To attack the problem a diamond-drilling program was undertaken, laid out on skeleton models of the deposit, in which the distribution of values appeared to be mainly horizontal. Boreholes spaced 30 ft. apart were drilled from drifts and crosscuts on the 250-ft. level to the 140 level above and from the latter to surface, at a minimum elevation of 75 deg. Results were satisfactory. O. J. Parker, Jr., general manager, will describe the work next month.

▼

Copper installed by the public utilities in the United States in 1938 totaled 62,200 tons, compared with 130,000 tons in 1930 and 83,000 tons in 1937, according to the American Bureau of Metal Statistics. Evidently there is room for improvement in the use of the metal, once "venture" capital comes out of hiding. Total domestic consumption in 1938 was 605,000 tons, or 9.29 lb. per person.

▼

How much gold escapes in placer mining operations? James M. Hill held that the loss was large, when he wrote (in *E. & M. J.*, October, 1935) that the placer miner "insists that a one-step operation—namely, running gravel through a pan rocker or sluice—will and must catch all his values." Obviously a recovery so high would be sheer magic, everything considered. P. Malozemoff states that operators are now recognizing that the tailings from almost all placer work contain appreciable losses. Methods of testing for such losses while the gravel is being mined are discussed by him in an article that will appear in July. Mr. Malozemoff is metallurgical engineer for Pan-American Engineering Company in Berkeley, Calif.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

H. W. CLARKE
Vice-President

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A Copper Coin, 7.5 lb. in weight, 10 by 11 in. in size, and Swedish in origin, being dated 1710 in the reign of Charles XII, is part of the copper industry's exhibit at the New York World's Fair. To go to market in those days one required a cart to handle the money, as in the still earlier days when iron was so used.

▼

Strict Warning regarding waffles and wool is given by Aluminum News-Letter's editor. Waffle molds of aluminum are not "irons," he admonishes; likewise aluminum wool for scouring is never to be termed "aluminum steel wool," save under risk of unnamed penalties. Readers will please take notice.

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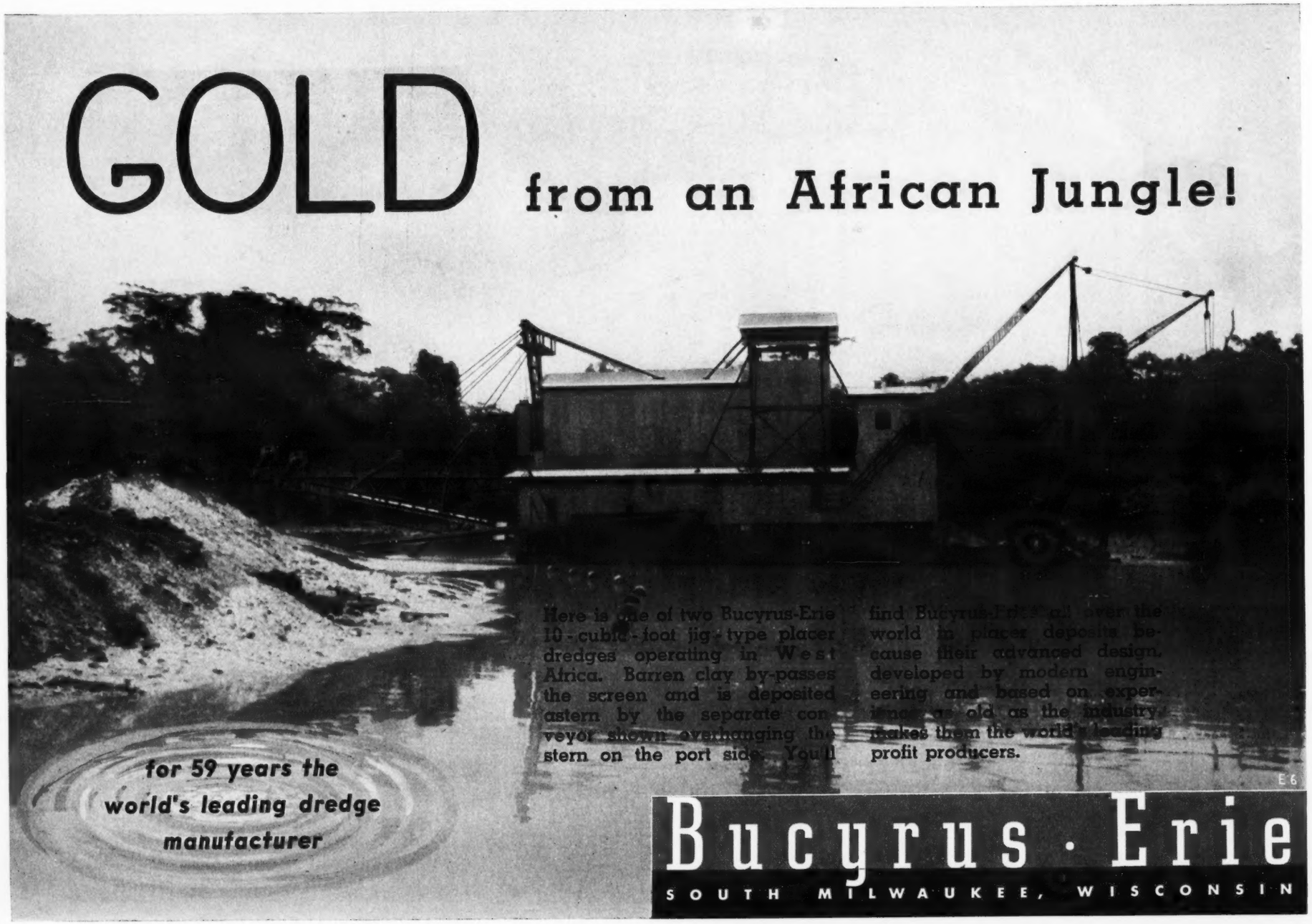
GOLD from an African Jungle!



Here is one of two Bucyrus-Erie 10-cubic-foot jig-type placer dredges operating in West Africa. Barren clay by-passes the screen and is deposited astern by the separate conveyor shown overhanging the stern on the port side. You'll find Bucyrus-Erie all over the world in placer deposits because their advanced design, developed by modern engineering and based on experience as old as the industry, makes them the world's leading profit producers.

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Volume 140 Number 6

JUNE, 1939

Under the Southern Cross

THE wooing of American capital by Brazil is earnestly under way. Already the stake of American investors in the industries and business of our Southern neighbor is large. That efforts should be directed toward increasing it is natural, and indeed such invitations need not be lacking in attractiveness. The country is great and growing. It has ample natural resources and a capable people. Internally it is prosperous. While at present foreign investors experience difficulty in getting their profits out of the country, this problem may yet be solved. Given continued stable government, Brazil should see its industries expand and multiply, its population grow, and its national wealth increase.

The country's abundant mineral resources would seem to be a lodestone to the foreign investor who is willing to take a speculative risk. That risk, however, must not be too great. Best known among these resources are the reserves of iron, manganese, and gold. Deposits of iron ore are found in Minas Geraes, São Paulo, Matto Grosso, and several other States. The total tonnage is very large. Brazil nevertheless lacks the corresponding reserves of coal, on which, together with the iron, a steel industry might be based, if indeed the population were large enough to supply a market. Important reserves of manganese and the bulk of the country's gold are also found in the State of Minas. And in many other widely scattered areas occur a variety of economic minerals, metallic and nonmetallic, as duly reported by the Geological Survey.

A great want in this extensive empire, however, is adequate transportation. And in addition much of the mineralized region is rugged in its topography, this in no way lightening the problem. Hence the slowness of the mining industry to develop and, in part, the need of capital.

At the same time, certain features of existing legislation in Brazil are doubtless acting as deterrents to new investment that might otherwise be made for mining purposes. When the head of the present Government continued himself in office by his coup of November, 1937, he promulgated the Constitution of Nov. 10 of that year, at the same time providing for submitting it to a plebescite, which has not been held to date. This document, in Article 143, provides that the right to "industrial use of mines and mineral deposits" depends on Federal authorization, which can be given only to Brazilians or to companies composed of Brazilian shareholders. Article 144, next, provides that "the law will regulate the progressive nationalization of mines, mineral deposits . . . as well as industries . . . essential to the economic or military defense of the nation." The latter would hardly reassure those with money to invest.

The Constitution provides, moreover (Article 13), that the President during the dissolution of the Chamber of Deputies may, if the needs of the State require, issue "decree-laws," with the exception of "modifications of the Constitution." On Dec. 14, 1937, Decree-Law No. 66 was so issued, in effect contrary to Article 143 of the Constitution, cited above, in that it apparently permits non-Brazilians to secure concessions through some roundabout holding-company procedure. Encouraging on its face, this new provision might nevertheless be construed as an illegal "modification of the Constitution" prohibited in Article 13 and a title acquired under its provisions might subsequently be invalidated. Indeed, the "decree-law" itself could be revoked.

Another element not conducive to enthusiasm on the part of foreign capital for new mining investment is the proposal in the "Decree-Law" cited to draft a Code of Mines to replace the one in effect since 1934. Should this new code include a certain recapture clause which passed the now-dissolved Chamber of Deputies in 1937, the effect would be most upsetting. That clause provided that the Government may, at all times, when the national interest requires, rescind the contract of the concessionaire after five years' operation, paying him the capital actually invested plus an indemnity to be arbitrated. What possibilities for wholesale expropriation this suggests, even though none actually be contemplated!

With such legislation on the record and in the air, it will be difficult to coax new money for mining out of strong-boxes. Invitations to invest and frightening legislation are not a persuasive combination. Those who direct affairs in Brazil will do well to review its laws and regulations pertaining to the mining industry to see if they cannot be improved.

Refuting a Libel

AS IN MANY another area throughout the world where a siliceous rock must be broken in the course of mining, the mine operators of the Tri-State zinc and lead district have to contend with silicosis and related tuberculosis as industrial hazards. The existence of this situation is common knowledge. For years it has received the careful attention of the mining companies, with which the United States Bureau of Mines has cooperated in bringing it under control. As long ago as 1925 the Bureau established a clinic where employees were examined, X-rayed incidentally, and given medical advice and care where needed. This clinic, which was finally turned over to the mining companies by the Bureau, functioned successfully up to 1932 and was well equipped and managed. The results achieved have worked for the mutual benefit of the employees and their families, the operating companies, and the several communities of the district.

It is therefore amazing to read in the *New York World-Telegram* of May 29 an article by a staff writer purporting to describe working conditions in the Tri-State area but grossly distorting the picture. The traveling photographer, who supplies the account, is quoted as saying he found sickness in every house entered on his visit; that there are 90,000 native-born people, there, half of them miners; that in Treece, one of the lesser communities of the district, the main street has been dubbed "the street of the walking dead"; that the men work underground with no ventilation, no blow fans, no exhaust fans, nothing to take care of the dust; that a driller's helper has about ten minutes every few hours to wet down the dust. He is quoted further as saying: "There are no workmen's compensation laws in Kansas and Oklahoma. In Missouri . . . the employers do not elect to have it." And so on, at greater length than can here be reproduced.

As a matter of fact, the Tri-State mining industry employed only 7,000 men in 1937, a boom year. The smelters that depend on the district's concentrates required 3,500 more, and an additional 4,000 were engaged in tributary occupations completely dependent on the industry. Word by word, the mischievous story could be refuted at length. Here it must suffice to quote Mr. Evan Just, secretary of the Tri-State Zinc and Lead Ore Producers Association, with headquarters at Picher, Okla. In response to a request from this magazine, Mr. Just wired as follows:

"Statements printed by *World-Telegram* are a gross distortion of true conditions in the Tri-State mining industry. This attack is probably part of a communist-sponsored program which has been in progress several months. Purpose is to sabotage our industry by dramatizing and exaggerating slum conditions which have existed near Picher since World War boom. These conditions constitute a serious local social problem, but are not attributable to the mining industry. Only a very small portion of these people work in the mines, remainder being principally on relief.

"Missouri, Kansas and Oklahoma all have modern workmen's compensation acts. Lead poisoning is not acquired in our mines. Air and dust conditions are carefully checked by our Association in all mines of its members, who account for 85 per cent of production. We use Government-endorsed technique and high standards. Faulty conditions are rare and promptly corrected. Natural ventilation, ordinarily ample, is supplemented where needed by mechanical blowers. Kansas Board of Health has investigated underground conditions and published bulletin. Surface dust conditions are not hazardous."

The Tri-State district is unfortunate in having so scandalous a story broadcast to the country just at a time when it is suffering from the thoughtless reduction in the zinc tariff imposed by the Canadian Trade Agreement that became effective on Jan. 1 last. No doubt those who inspired this attack chose the moment as opportune.

Shoveling in Japan

MODERNIZATION of industry in Japan has been so extensive that many will feel astonished on reading the story told on another page by M. J. Elsing of the recent initiation of the Japanese miner into the art of hand-shoveling as the Western miner commonly does it—when he shovels by hand. This capitulation of the *mi* and the *kassa*, which apparently are traditional implements of the Japanese, to the long-handled "round-point" shovel is occasion for surprise merely because of the common assumption that such quaint tools and practices must have passed out long ago with the shoguns, so to speak. No doubt excellent work has been done by the Japanese with his three-cornered hoe, which must be well adapted to the temperament and physical characteristics of its users, else it would scarcely have lasted for the two generations and more that have elapsed since the introduction of innovations from the Western world began. Perhaps there have been wielders of it who could have shown an Arizona mucker a thing or two.

One must not conclude that all shoveling is similarly old-fashioned in the Land of the Rising Sun. There the power shovel has long since won its place and the acceptance of excavating equipment is quite general. Actual imports of such machinery from the United States are of substantial volume. When the well-known propensity of the Japanese for "building their own" from Western models is taken into account, to say nothing of native invention, it may be assumed that a large number of such units is actually in service.

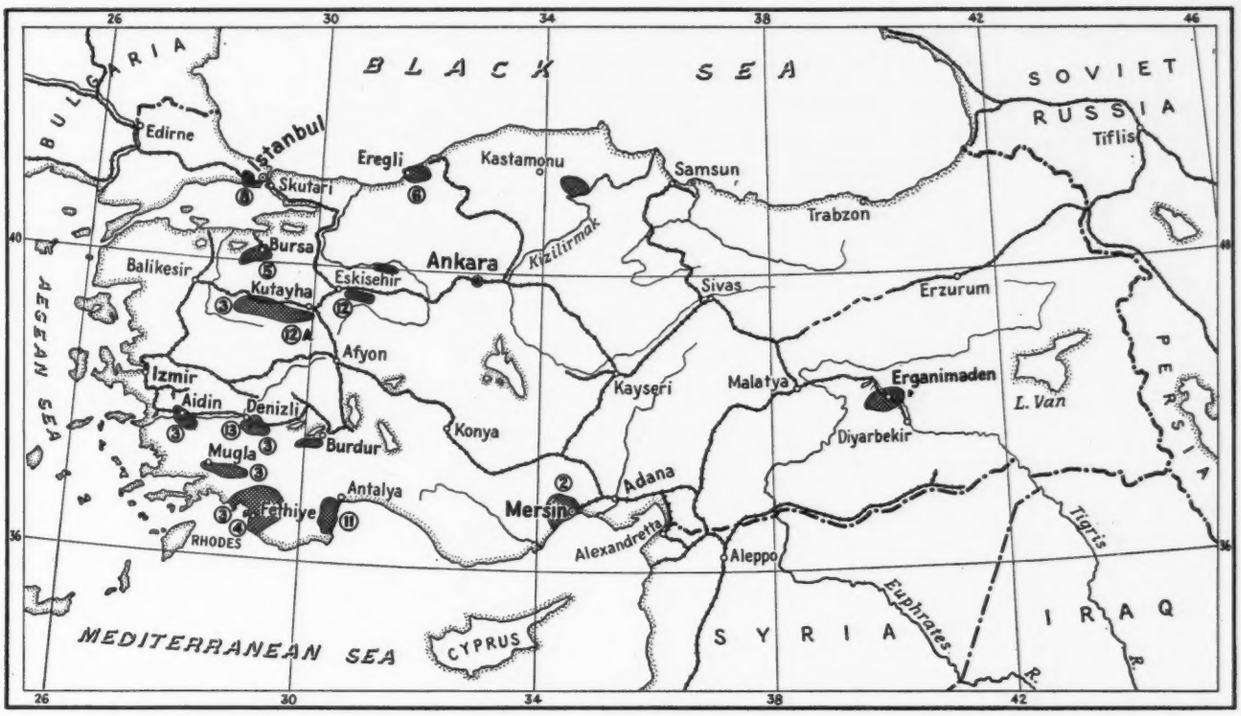


Fig. 1 . . . Modern Turkey. The map shows the districts in which chrome ore is being mined or is known to occur

Turkey and Its Chrome Ore

The country grows in importance as a producer, leading the list in 1938 with 208,000 tons

Enoch Perkins

Mutual Chemical Company of America
270 Madison Ave., New York

CHROME ore was first discovered in Asia Minor in 1848 by an American, J. Lawrence Smith, at a point near Bursa. During the two decades preceding, the world's demands for this mineral had been met by Isaac Tyson, founder of the Baltimore Chrome Works of the Mutual Chemical Company of America, who continued to supply them until 1860, the ore coming from his Reed mine, in Maryland, and the famous Wood mine, in Lancaster County, Pa., which is credited with an output of 95,000 tons. In 1860, Turkey supplanted Tyson in supplying the world with chrome, drawing its ore first from the Bursa deposits and later from those discovered at Makri in 1877. The country remained the principal source of the mineral for the next 33 years. At the end of this period it in turn yielded first place to New Caledonia, the production of which had been mounting since the Lucky Hit mine made its initial output in 1885, followed in 1888 by the Alice Louise and the Josephine mines, all three of which were situated in the southern end of the island.

Ore was first exported from New Caledonia in 1886, when 1,200 tons was shipped. In 1900 the Bellacosia mine, on the Tiebaghi Dome in the island, went into production, and in 1901 the Vieille Montagne No. 2. The next year the Tiebaghi mine became active, almost immediately attaining an annual production rate of nearly 50,000 tons and thereby offering serious competition to the Turkish ores.

In 1910, the Chrome Trust had its beginning as such, the first unit being formed when the Tiebaghi mine was sold by Bernheim's Société la Chrome to a newly organized company connected with the Sir Edmund Davis group, known as the Société le Tiebaghi. In 1911, a second unit, the Rhodesian Chrome Mines Limited, acquired the famous Selukwe chrome deposits in Southern Rhodesia. In 1914, the Baluchistan Chrome Company, controlling the chrome ore deposits in Baluchistan, was added to the Trust, which through these three companies now controlled 85 per cent of the world's chrome production.

In the face of this progressively increasing competition, Turkey's output of chrome ore soon fell off to the point where, in 1921, it was a mere 2,500 tons. The annual output remained less than 10,000 tons until 1927, when 18,000 tons was produced. This revival came about through the formation in 1927 of the Société Minière de Fethiye, in which, it is said, Minerais et Metaux, the Société de Peñarroya, the Comptoir Lyon Alemand, and the Société de Balya Karaidin were interested. The mines were those formerly owned by Stanley Patterson in the vilayet of Aidin (3 on the map, Fig. 1), Denizili (13) (3), Burdur, and Menteshe. Patterson leased the mines to the new company on a royalty basis. The Fethiye company, once operating, eventually reached a production of 80,000 to 90,000 tons annually, the effect of which was to increase the output of Turkey to 29,000 tons in 1930, 55,000 in 1931, 75,000 in 1933, and 119,000 tons in 1934.

The second phase in the increase in chrome ore production in Turkey came about in 1935, when new laws were passed enabling the Government to re-

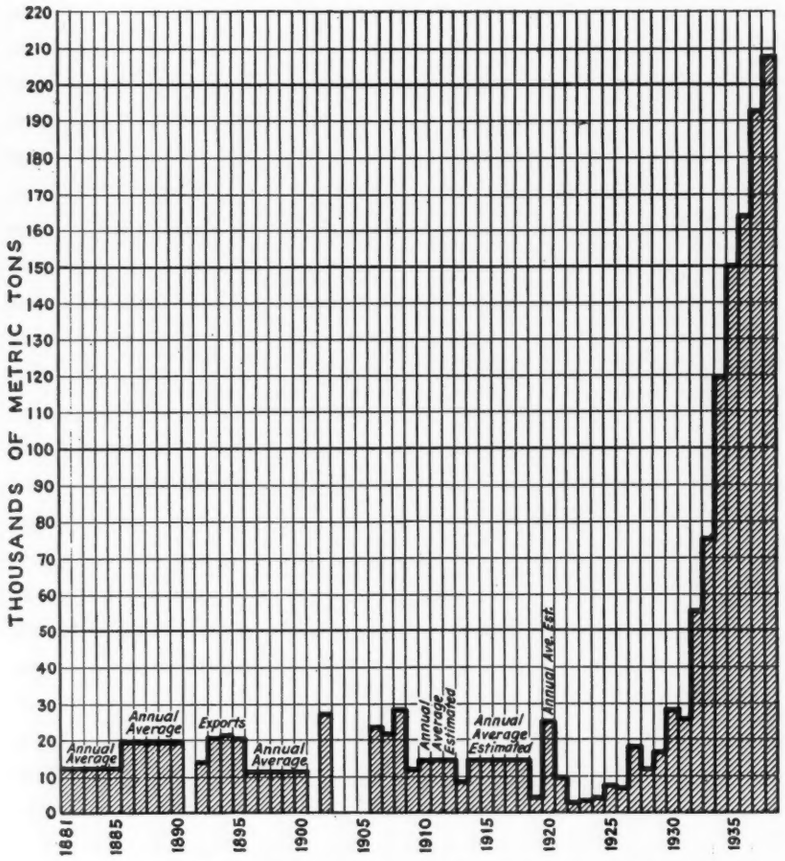


Fig. 2 . . . Production of chrome ore in Turkey from 1881 to 1938 inclusive. The great rise has taken place since the advent of the new Republican regime in 1923

habilitate the country's mining industry and develop it on a sound basis. Up to this time, the industry, save for the Fethiye operation, lay paralyzed through inadequate regulation, allowing the control of the country's mineral resources to pass into the hands of speculators, often not even Turkish subjects, whose only interests lay in the promotion, sale, and resale of potential mining enterprises, with no thought of operating the properties in intelligent or orderly fashion.

On the enactment of the new mining laws, the National Assembly on June 14, 1935, established an Institute of Mining Research and Geological Survey (or Prospecting) for the purpose of developing the mineral resources of the country, including oil. The Institute was also given charge of educating and training engineers and skilled artisans, as required, in the work of improving and developing the industry.

In addition to the formation of the Institute, a second law was passed, likewise on June 14, 1935, establishing the Eti Bank, with a nominal capital of 20,000,000 Turkish pounds and the right to double this amount if required. The Eti Bank operates in exactly the same fashion as any commercial institution and has been given complete charge of the mining industry in Turkey, including the purchase, equipment, and operation of properties, as well as the disposal of the ores and minerals in the world's markets.

Chrome ore was given immediate attention, and the Guleman mine, in eastern Turkey, was developed and placed in operation early in 1936. Its production in 1937 amounted to 46,572 tons, in 1938 to 76,680 tons, and for 1939 has been set at 100,000 tons. As a result of this stimulus, chrome ore production in Turkey rose to 163,000 metric tons in 1936, to 192,000 tons in 1937, and reached an all-time high of 208,405 tons in 1938, as indicated in the accompanying graph. Thus after a lapse of nearly 80 years Turkey has again become the world's largest producer of chrome ore.

Consumers and Producers — The countries that are consumers of Turkish chrome ore may be seen from the table which gives the exports of the ore during the past eleven years. It will be noted that the largest consumers of Turkish ores have been Germany, Sweden, Holland, France, and United States, with Italy a large buyer in 1938 for obvious reasons.

The principal producers of chrome ore in Turkey today are the Société Minière de Fethiye, controlled by Minerais et Metaux, the German-Swiss controlled Turk Maden Sirketi, the Société Anonyme Turque de Chrome, Stanley Patterson of Izmir, and the Eti Bank. The districts contributing to the current production are briefly as follows:

The Marmaris district (Fig. 1, Ref. 3) is said to be producing about 10,000 tons of low-grade ore a year, running about 40 per cent Cr_2O_3.

Production of chrome ore in the Eskisehir district (Fig. 1, Ref. 12) has occurred only recently. The ore runs between 51 and 52 per cent Cr_2O_3, and the output has been estimated to be approximately 40,000 tons annually. The mines are 40 km. from the railroad.

Chrome deposits of the Denizili-Tefenni district (Fig. 1, Refs. 3 and 13) are situated about 60 km. from the Izmir-Aydin Railroad and are at present being prospected by the aforesaid Institute for Mining Research and Prospecting. The area is said to

Turkish Chrome Ore Exports, by Ports

Metric Tons

Port of Shipment	1928	1929	1930	1931	1932
Fethiye	1,449	.....	300	No details	No details
Gocek	400	.....	.....	" "	" "
Derince	10,000	13,100	26,253	" "	" "
Cavus burnu	.....	3,076	1,542	" "	" "
Totals	11,849	16,176	28,092	33,063	55,749

Turkish Chrome Ore Exports, by Countries of Destination

Metric Tons

Country of Destination	1933	1934	1935	1936	1937	1938
United States	30,675	35,087	21,044	13,919	12,751	9,048
Germany	11,836	30,349	40,426	64,474	30,269	22,803
Sweden	32,905	21,945	31,312	34,587	1,270	15,481
France	17,077	14,979	16,446	16,936	7,960	9,028
England	7,966	5,182	5,862	1,017	.....	3,650
Italy	5,049	5,405	9,355	1,016	500	18,295
Belgium	2,218	80	3,416	650	.....	.....
Holland	1,179	270	4,611	9,985	11,481	12,561
Spain	254	245	51	51	.....	.....
Norway	400	4,980	7,522	4,875	3,794	2,848
Denmark	.....	1,530	508	.....	.....	.....
Finland	.....	356	.....	1,068	1,016	1,218
Poland	.....	970	965	864	.....	.....
Czechoslovakia	.....	.....	785	200	.....	500
Greece	.....	.....	1,320	.....	.....	.....
Switzerland	.....	.....	1,050	.....	.....	.....
Austria	.....	.....	.....	.....	93	4,414
Other countries	.....	740	1,050	.....	.....	.....
Totals	109,559	122,118	145,723	149,642	69,134	99,846

The Guleman chrome ore camp, northeast of the railroad at Erganimaden, as the crow flies. An aerial tramway connects the two points

be showing up well, some ore running as high as 54 per cent Cr_2O_3 having been found.

The Mersin district, which centers around Mersin, the shipping port for the Guleman mine (Fig. 1, Ref. 2), has its activities principally at Evrenli, 30 km. northwest of Mersin. It contains a number of low-grade deposits running between 40 and 47 per cent CR_2O_3, operated mainly by individuals.

The Fethiye mines, operated by the Société Minière de Fethiye, are, as already mentioned, situated near Fethiye, on the Gulf of Makri, as may be seen on the map. The principal deposits occur at Kargi-Foca and at Cenger, 9 km. and 21 km. from the sea respectively. Patterson removed most of the surface ore before leasing the properties to Société Minière de Fethiye on a royalty basis. The ore is won from several mines, which are served by a narrow-gage railroad about 15 km. long and running to the sea. Some lump ore, 44 to 45 per cent and 47 to 48 per cent in grade, is produced by sorting, but the larger part of the output is in the form of concentrates running 50 to 52 per cent Cr_2O_3. Crude ore sent to the mill is believed to range between 35 to 40 per cent Cr_2O_3 in grade. The annual production rate has been in the neighborhood of 80,000 to 90,000 tons, the greater part of the output being disposed of in Europe.

The Dagh Ardi chrome district is in the township of the same name in Tavshanli County, in the Province of Kutahya. The principal mines, including the famous Dagh Ardi mine itself, are near the village of Tavshanli. Many deposits of chrome ore have been reported in this section, some of the estimates for the ore reserves being as high as 10,000,000 tons (Fig. 1, Ref. 12).

In 1916 the Dagh Ardi mine was acquired by the German concern, Gebrueder Roechling, of Munich; a Turkish operating company known as the Turk Maden Sirketi, was organized to exploit it and adjacent chrome properties. After the War, Gebrueder Roechling disposed of their interests in this field to a large shareholder of their company, the German firm of Gruenfeld & Kohler, which joined hands with a Swedish company, the Aktiebolaget Ferro-legeringer of Stockholm, a ferro-alloy manufacturing company with a plant at Trollhattan, Sweden. Likewise, the German ferro-alloy manufacturer, Elektro-Metallurgie of Nürnberg, gained an interest. The Turk Maden Sirketi is still the operating company for the German-Swedish group and has now acquired chrome properties in Kutahya, formerly owned by the German firm, Anatolische Bergbau Gesellschaft, which was dissolved.

The Dagh Ardi is one of the world's outstanding chrome mines. It has produced ore for nearly 40 years. It was run during the War by A. G. Krupp, of Essen, then by the firm of Roechling Brothers, to be followed by Deutsche Chrom Grube Gesellschaft.

Annual Imports of Turkish Chrome Ore in United States

Metric Tons

Year	Amount	Year	Amount
1910	1,100	1929	1,700
1912	11,030	1930	2,541
1913	8,650	1931	2,198
1914	11,880	1932	17,602
1915–1918	None	1933	27,854
1919	3,500	1934	28,730
1920	12,760	1935	16,060
1921	3,823	1936	19,490
1922–1927	None	1937	33,571
1928	200	1938	20,392

The ore occurs as a pipe with a considerable persistence in depth. Both milling and high-grade metallurgical lump ore are produced. The finished ore is carried by an aerial tramway to the railroad station at Degirmisaz (Fig. 1, Ref. 12A). Production has run between 30,000 and 40,000 tons a year. In 1934, 36,000 tons was produced and 37,000 tons shipped. No ore is sold in the open market, it being consumed by the German and Swedish ferro-alloy manufacturers interested in the property.

Chrome in Eastern Turkey

The chrome deposits of eastern Turkey are in Elazig Province, in Anatolia, between the villages of Erganimaden and Palu, some 450 miles and 40 hours by train from Ankara, the capital of Turkey (Figs. 1 and 3). Ankara in turn is 375 miles and overnight by train from Istanbul. Anatolia eastward from Ankara is very mountainous and largely devoid of vegetation save in the river valleys, where land suitable for cultivation may be found. This region of eastern Turkey is part of a military zone reaching to both the Russian and Syrian borders. The town of Diyarbekir, a key military post, is 50 miles south of Erganimaden.

In the Elazig area the chrome deposits, all of which, with the exception of the Guleman, were discovered by the Government's Institute for Mining Research and Prospecting, are distributed over an area 18 km. wide and 30 long (Fig. 3). They comprise the following groups, to which others may easily be added as prospecting continues:

Guleman (Saisin, Tosin, Sayver, Golelin, and Bani), Kundikan, Sorudag, Kefdag, Bahrubeseren, Asgiha-

mel (Buyuk Hamel), Karacesme, Rutday, Esekmeydani, Vasaiye, Hamele-His-Boban, Genefi, Asagivartenik (Ahirderesi), Yukarisinkirik (between Yukarisinkirik and Asagisinkirik), Herbitayayla (belonging to the village of Visin), Bagin (Ortenekderesi), Mahman.

The Sorudag group includes the Buyuk Hamel, the Tenk Yilanderesi, and the Kefdag. This group is well thought of and is considered to have possibilities of becoming eventually an important factor in the production of the Yukari-Sinkirik and Asagivartenik groups the ore is low-grade, this deferring their day of operation pending the production of richer ores from the other deposits.

As is often the case, such as at the Bellacosia and Vieille Montagne and other mines in New Caledonia, a certain amount of alluvial ores, with occasional chrome boulders, are found on the slopes of the valleys along stream beds below known deposits of ore in place. In addition, chrome boulders occur extensively in the near-

everyone in an effort to find out where they came from, but months of investigation failed to bear fruit. However, he did learn that the wood had been cut in the Pirajaman district. A visit to this district revealed only barren serpentine. Subsequently, he took up the matter with the military authorities of the mines and was told of a private, Halie by name, who was familiar with the Ergani district. The soldier recognized the specimens as being plentiful in the mountains back of the Ergani mines. An expedition was or-

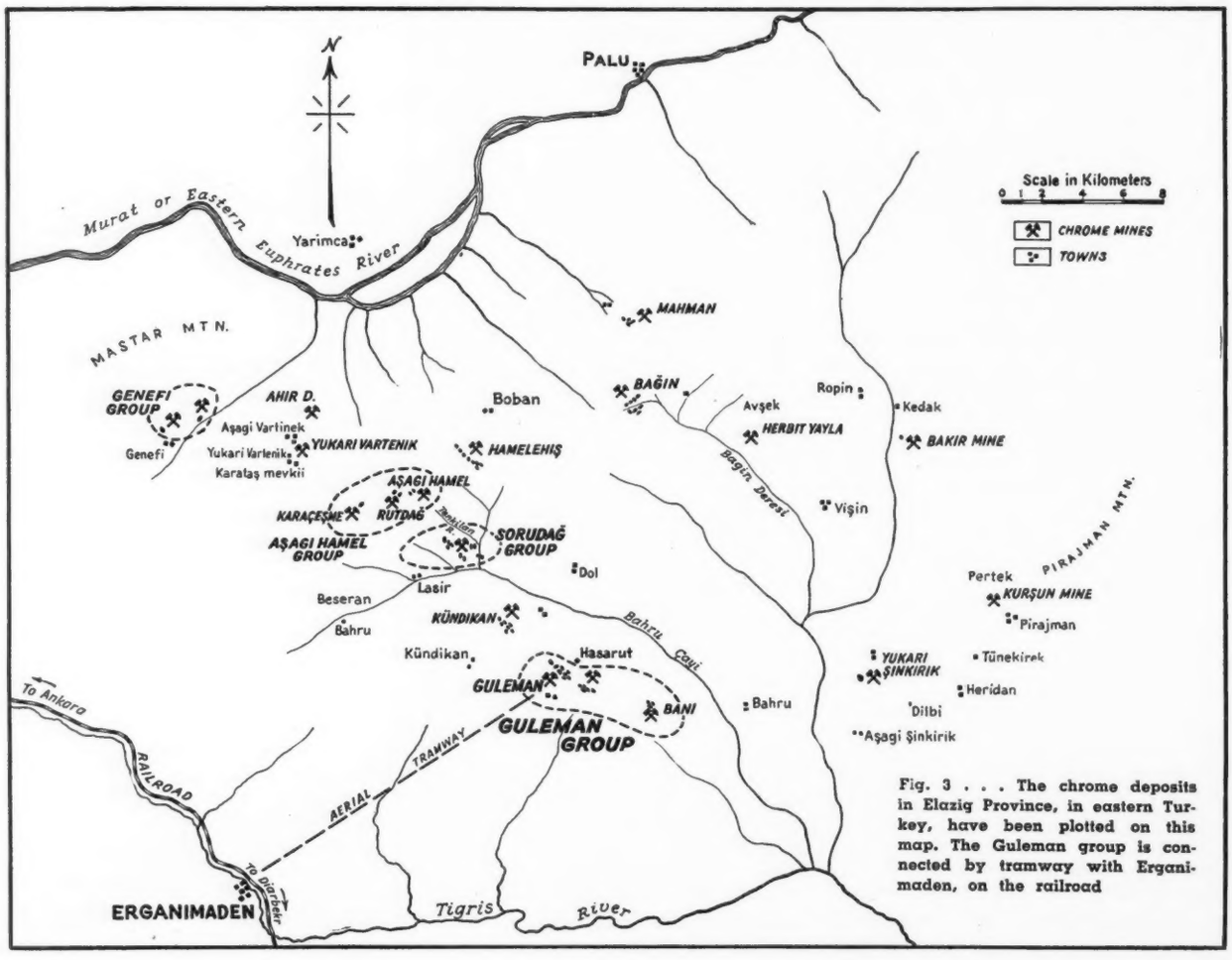


Fig. 3 . . . The chrome deposits in Elaziq Province, in eastern Turkey, have been plotted on this map. The Guleman group is connected by tramway with Erganimaden, on the railroad

chrome ore in eastern Turkey, despite the fact that the deposits are scattered over an extensive area, somewhat complicating the problem of transportation.

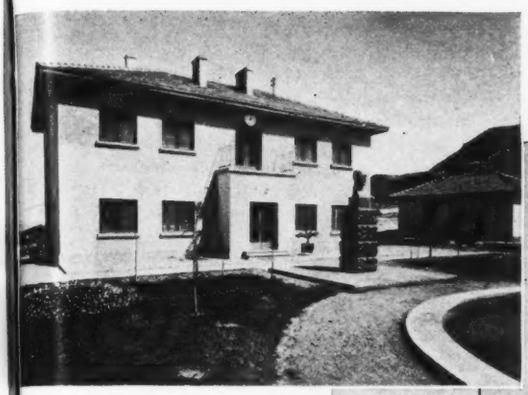
Five miles north of the Sorudag group is the Hamele-His-Boban group, lying between Hamele-His and Boban. Both could be served by putting an old military railroad running to the village of Dol into condition for automobile travel, and continuing it to Boban. The Bagin-Ortenekderesi group, as in the case with the Mahman, is inaccessible at present for exploration. The Genefi group, along with the Herbityayla deposits, is at present considered to contain insufficient ores for economical mining. In by fields similar to some occurrences in India.

The Guleman Group—This group, including the Golelin, Bani, and the smaller but high-grade Kundjkan deposits, is 18 km., as the crow flies, northeast of Erganimaden at an elevation of 1,300 meters between the Eastern Euphrates and the Tigris Rivers. It is here that the only chrome deposit in eastern Anatolia is being worked at present, that of the Guleman mine.

In 1915, Abdullah Husrev, while acting as chief engineer for the Ergani copper mine, in the course of inspecting a wood storage building, found several pieces of chrome ore mixed in with the wood. He questioned

ganized, which finally reached the village of Guleman. Here chrome float was discovered in the river beds near the village. With this as a guide, subsequent search discovered what is now the Guleman mine as well as the other deposits between the Guleman and Heserat. The find was reported to the Department of Agriculture, but nothing was done towards opening up the deposits until the new mining régime came into power in 1935.

The Guleman mine proper shows eighteen different outcrops extending over an area of 350 to 700 meters, all of varying but generally elliptically rounded shapes, some of which, as proved by mine development, bear evidence of a considerable persistence in

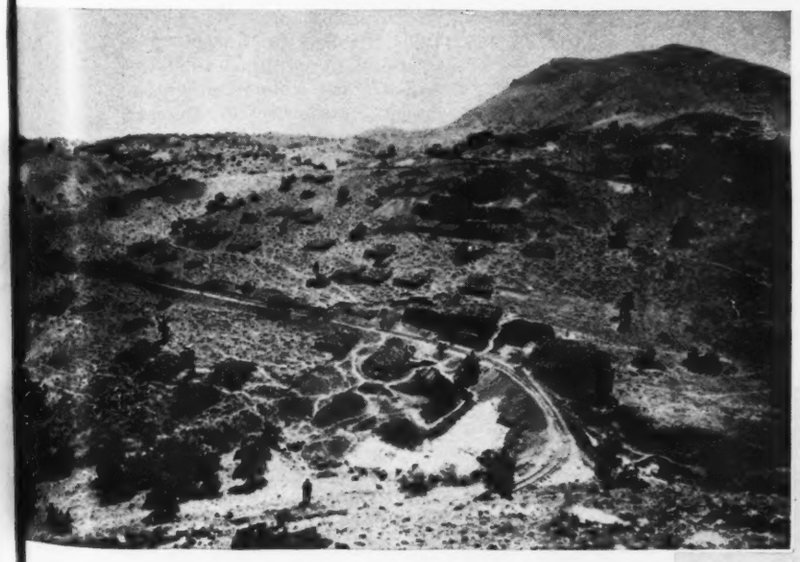


Above—The staff house on Ataturk Square

Above at right—The dining room of the staff house

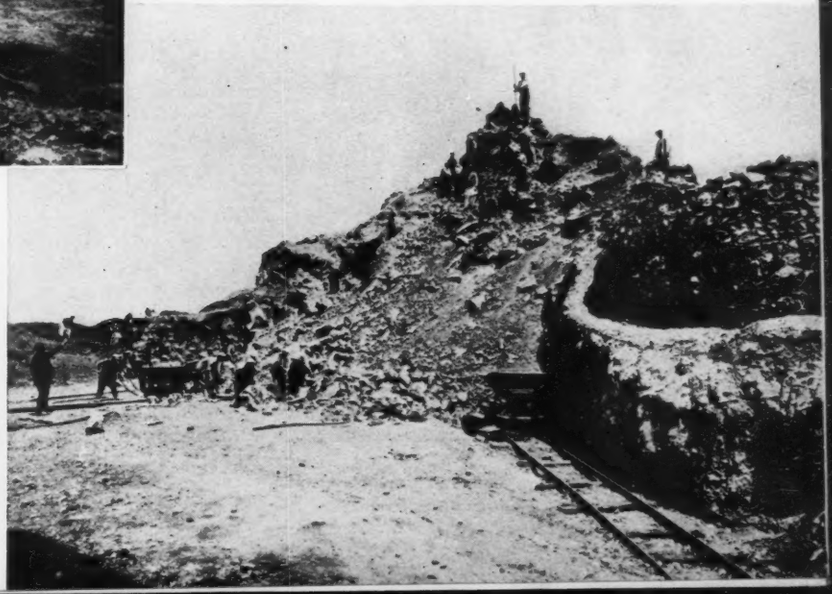
Right — Ataturk Square, in Guleman. The bust at the right is that of the late Kemal Ataturk, founder of modern Turkey

A street in Guleman



Left—At the Guleman mine, at a period in its early history. The rectangles on the hillside are neatly stacked piles of chrome ore, produced by tributers. Below—Mining chrome ore in an open cut at Guleman

The wire-rope tramway that takes the chrome ore from Guleman to the railroad at



Analysis of Official Out-Turn Samples of Shipment of Guleman Ore Into United States

Analysis No.	Cr_2O_3	Fe	SiO_2	Al_2O_3	MgO	CaO	Carbon	Cr:Fe
A	50.42	10.86	2.21	....	....	....	....	3.18 :1
B	49.83	10.87	2.79	....	....	....	....	3.13 :1
C	50.08	10.97	3.17	....	....	....	....	3.12 :1
1	52.32	11.13	2.18	15.22	14.81	2.44	....	3.29 :1
2	49.60	10.63	2.11	16.16	16.4	1.23	....	3.19 :1
3	52.06	10.82	....	....	....	....	....	3.29 :1
4	51.74	11.20	....	....	....	....	....	3.147:1
5	51.74	10 91	....	....	....	....	0.04	3.245:1
5A	51.74	10.91	....	....	....	....	0.066	3.245:1
6	51.77	11.17	2.63	....	....	....	....	3.17 :1
7	51.78	11.19	2.62	....	....	....	....	3.17 :1

depth as pipes. Others remain to be tested; and in one or two instances smaller and less important surface showings have been found to pinch out at depths of 25 or 30 meters below the outcrops.

Up to now, the largest outcrop developed at Guleman has a surface area of over 4,000 square meters, being but slightly smaller than the vein area of the world-famous Tiebaghi mine, in New Caledonia, a producer thus far of well over a million tons of 56.50 per cent Cr_2O_3 ore. The country rock is serpentine and the ore ranges in physical make-up from massive specular to loosely held coarsely crystalline, in much the same fashion as the ore in the Fantoche mine, in New Caledonia, as well as certain ores in Southern Rhodesia. Both the Cr_2O_3 and the iron contents tend to be richer in the center of the deposits than along the margins near the serpentine.

The topography allows open-cut mining from benches, neither hoisting nor pumping being required. Drilling is done with jackhammers, compressed air and electric power being supplied by a diesel power plant. Attention is given to ore grades, with respect to both Cr_2O_3 and iron. Several grades are made up into stocks of approximately 125 tons each, at the various working faces, which, after careful sampling for Cr_2O_3 and iron, are so blended as to meet the particular specifications required.

Shipments are remarkably uniform in grade, as may be seen from the table listing official out-turn analyses of ore shipments. Here it will be noted that the usual Cr_2O_3 content is well over 50 per cent, with silica as low as 2.11 and a chromium-iron ratio in excess of 3:1. In addition, the carbon content is suitable for low-carbon ferrochrome manufacture, all of which combine to render the Guleman ore one of the finest metallurgical ores in the world.

Typical Screen Analysis of Guleman Ore

Size, In.	%
Plus 10	25
Minus 10 plus 5	30
Minus 5 plus 2	15
Minus 2 plus ½	20
Minus ½	10

Typical Analysis, Guleman High-Grade Lump Ore

Cr_2O_3	51.72	SiO_2	2.51
FeO	10.40	P	Trace
Fe_2O_3	4.36	S	0.02
Al_2O_3	13.85	C	0.04
CaO	0.14	Ignition loss	0.95
MgO	15.78	Ni	None
MnO	0.17	Cr-Fe ratio	3.17

Ore Transportation—The broken ore is hauled from the open cuts by a diesel locomotive in 330-liter rocker-dump cars on 60-cm. gage tracks to stock at the head of the aerial tram, where it is reclaimed by hand as may be required in supplying the tramway. Pending the completion of the latter, the ore was trucked to the railroad at Erganimaden over an indifferent road 25 km. long, which was often snowed in from December to March. The tramway which now carries the ore to the railroad station at Erganimaden is a Pohlig installation 18 km. long, broken up into several sections. Little power is required to operate it. In design it has double ropes on steel towers with 125 buckets carrying 300 to 500 kg. each. The time required from mine to terminal is one hour forty-eight minutes, providing a capacity of 20 tons per hour. The buckets discharge into 6,000-ton concrete loading bins so divided as to accept three different qualities of ores. The ore is loaded into 1.50-meter gage railroad cars carrying from 12 to 57 tons.

From Erganimaden to Mersin, the shipping port, the distance is 630 km. by rail, requiring 25 hours. The ore is stocked on shore pending the loading of steamers. Mersin is an open roadstead where the vessels lie at anchor half a mile from shore during the loading. The ore is picked up by hand from stock in 1-ton Decauville rocker-dump cars, weighed on automatic scales, and loaded into lighters, all on contract at a rate of 600 to 800 tons daily. The vessels usually require about 40 days to reach eastern Atlantic ports.

Social Welfare—The accomplishments of the Eti Bank in providing better living and working conditions in the mining districts have been remarkable and must be seen to be appreciated. Change houses have been provided, with running hot and cold water. Single men live in well-built dormitories. Married men of the staff are provided with well-constructed, comfortable cottages in the best possible surroundings, equipped with electric lights, running water, and sewage disposal. A club house at Guleman provides a library, private dining hall, and recreation rooms. Meeting halls for amusements and public gatherings have also been built. Hospitals are adequately equipped, with doctors and nurses in continual attendance, many of whom, thanks to the modern Turkey, are women.

Ore Reserves—Pending completion of further exploration and development work on the known deposits of chrome ore in Turkey, it is impossible to estimate the quantity of ore known to exist in Turkey today. At the Guleman mine the fully developed ore reserves have been set at nearly 750,000 tons, with every indication that the output from this mine alone can reasonably be expected to reach well over 1,000,000 tons of high-grade ore.

With this as a yardstick, and keeping in mind the many new deposits that have been uncovered as well as the energetic search for new deposits which is currently meeting with success, one may expect Turkey to continue as one of the world's most important suppliers of chrome ore for many years to come.

Sampling Turkish chrome ore at Baltimore after unloading it from the boat. Through this American port 120,000 tons was imported in 1938 and 171,183 tons in 1937

What the Records Indicate As to Mine Assessment Work

An analysis of the problem of continued suspension, based on a survey

A. L. Flagg
Consulting Engineer
Phoenix, Ariz.

THE subject of annual labor requirements on unpatented mining claims threatens to take its place in the list of events which generally are accepted as infallible signs of the coming of spring. It would seem that enough discussion has already been aired on the subject, but unfortunately there does not appear to be a solution in the offing, and the problem is still with us. Those who would enforce the requirements rigidly have an array of arguments quite as commanding as those who would continue to remit the work, with or without certain restrictions. So far there has been no attempt to examine and compare the relative benefits to claim owners or to determine the status of claim owners and how that status might affect any decision regarding the proper course to be pursued in trying to arrive at a solution of the problem. Perhaps the results of a survey of this sort cannot be expressed in numbers sufficiently accurate to be of value, yet it does seem that it should be possible to reduce the advantages and disadvantages to comparable units, which would be a step in the direction of a more intelligent analysis of the problem from the standpoint of actual benefits.

No one denies that there may arise exigencies warranting the suspension of the annual labor requirements, particularly when claim owners are drafted for military service. Neither is it unreasonable to grant the same relief in times of severe depression, though there is a potent argument in the very great need of employment by many men during such times, making it difficult to determine which is the more desirable—the relief of claim owners, or employment for those who could and would do that kind of work. The objection to repeated suspension of the assessment requirement is the pronounced tendency toward the development of a Government-fostered racket. An examination and thoughtful study of the mining records in any mining community indicates an unmistakable trend that way.

It is unnecessary to dwell on the purposes for which the law was framed originally. All are agreed that it was desirable to stimulate the development of our mineral resources, and in keeping with the spirit of our expanding young country, to afford an equal opportunity to all.

When our mining law was put into practice, the miner did the mining and the prospector could be depended upon to do the prospecting. It is true that now and then there was an interchange of occupation between these two characters, for either could and did assume the rôle of the other for short periods. It was convenient for the prospector to mine a bit, thereby accumulating funds with which to continue his prospecting. To a limited degree this is done today. Under such conditions most of the provisions of our mining laws met the requirements of the times, though not considered perfect.

Prospecting has become increasingly hazardous and less remunerative. A few of the old school of prospectors survive, but the number is fast diminishing. They carry on their work under a great many handicaps not known a quarter of a century ago. Today the prospector is bedeviled by prohibitions of one sort and another which seem to him to be unfair and perhaps not too well understood even by the ones who raised these prohibitions. Some of these handicaps are more annoying than others, completely nullifying the advantages of improvements in tools, working conditions, transportation, and the like.

The prospector bears the burden of the initial effort to make a mine. There is no easy formula for accomplishing this. He must select an area outside the forbidden zone; and then, having in mind many restrictions, he works away until his efforts are rewarded or he is obliged to give up in order to make a living. If he does "strike it rich" his troubles are not over but just become another sort, perhaps even more perplexing.

Because of these changed conditions the old-time prospector has almost disappeared. His place has been taken by other individuals or loosely formed partnerships attempting to perform the function of a prospector but engaging in this pursuit more as an avocation than as a regular occupation. It is because of this change in the character of the largest group of claim owners that there has been an increasing desire to hold mining claims by location indefinitely and to do so at a minimum of effort or expense.

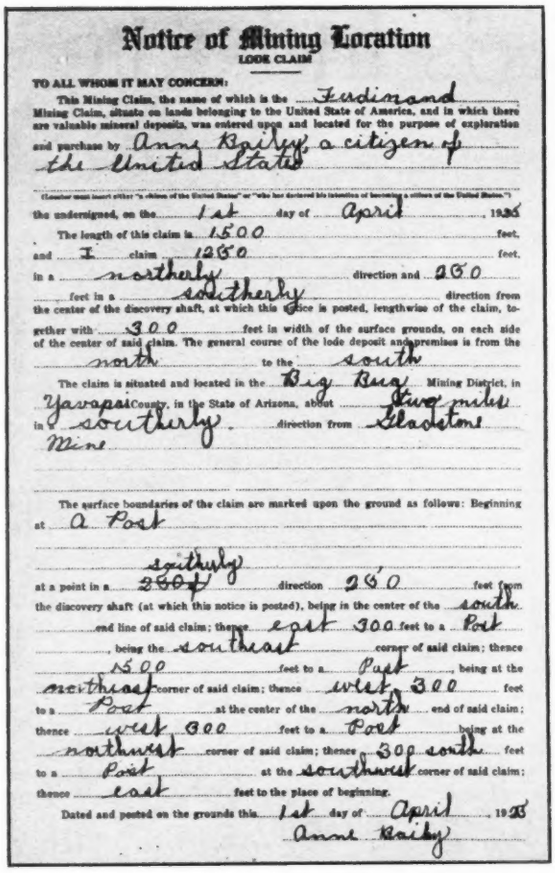
Before any estimate of the comparative advantages to claim holders can be arrived at, it is necessary to know, in a general way, what kind of people hold the unpatented claims. It would seem that they might be catalogued in three general groups.

First, we have the well-organized and successful operating mining companies, commonly referred to as the "big companies," and, in many mining communities, loosely damned by everybody for everything. So far as can be discovered these organizations do not seek exemption but rather perform, with good measure, their annual labor requirements. Therefore it is not necessary to include them in an effort to measure the advantages or disadvantages of suspending the annual labor requirements at any time.

In the second group should be placed all the other companies, large or small; operating or idle; new or old. The "corporations for convenience," those cases where a few associates have incorporated in order to handle their joint interests the better, as well as formal partnerships of every sort, are in this group.

The third group consists of the individual claim owners. This is the largest group and represents the largest holdings. Perhaps as much as 75 per cent of the claims held by location are held by individuals. A count of several thousand instruments, both affidavits of labor and notices of intention to hold claims under an act providing for the suspension of annual labor requirements, provided the data referred to in this discussion. The count was made principally in counties in Arizona, but some other data have been made available.

It may seem trivial even to refer to a small group of irresponsible claim locators, made up of campers, speculators, and adventurers, many of whom are more or less ignorant of the nature of the obligation they have assumed when they have posted a notice in a monument. However, this group is large enough and sufficiently active in some localities to be a real nuisance. These locations are rarely completed, and that many are recorded even when no attempt has been



Notice of Mining Location

LODE CLAIM

TO ALL WHOM IT MAY CONCERN:

This Mining Claim, the name of which is the Ferdinand Mining Claim, situate on lands belonging to the United State of America, and in which there are valuable mineral deposits, was entered upon and located for the purpose of exploration and purchase by Anne Bailey, a citizen of the United States

(Locator must insert either "a citizen of the United States" or "who has declared his intention of becoming a citizen of the United States.")

the undersigned, on the 1st day of April 1935

The length of this claim is 1500 feet, and 1 claim 1250 feet, in a northerly direction and 250 feet in a southerly direction from the center of the discovery shaft, at which this notice is posted, lengthwise of the claim, together with 300 feet in width of the surface grounds, on each side of the center of said claim. The general course of the lode deposit and premises is from the north to the south

The claim is situated and located in the Big Bug Mining District, in Yavapai County, in the State of Arizona, about two miles in southerly direction from Gladstone Mine

The surface boundaries of the claim are marked upon the ground as follows: Beginning at a Post

at a point in a southerly direction 250 feet from the discovery shaft (at which this notice is posted), being in the center of the south end line of said claim; thence east 300 feet to a Post, being the southeast corner of said claim; thence N 500 feet to a Post, being at the northeast corner of said claim; thence west 300 feet to a Post at the center of the north end of said claim; thence west 300 feet to a Post being at the northwest corner of said claim; thence 300 south feet to a Post at the southwest corner of said claim; thence east feet to the place of beginning.

Dated and posted on the grounds this 1st day of April 1935

Anne Bailey

Photographic reduction of a "notice of mining location" made out for a "supposed" lode claim in Arizona. The name of the locator is fictitious

made to do the discovery work is surprising. Unless one knows all the circumstances, it is almost impossible to distinguish between a location of this sort and one that is valid. The difficulty increases if the locator should happen to start a discovery or build one or two monuments, and further complications arise if the annual labor requirements are suspended about that time.

Having set up several classes of claim holders, perhaps not too nicely differentiated, let us see what the county records for the year ended at noon July 1, 1938, will show. Such an analysis as follows cannot be looked upon as complete. Obviously, to determine all the facts concerning several thousand claims considered in this study would involve a tremendous amount of work and would almost necessitate a personal interview with each claimant. Records were consulted over a wide territory and in more than one State, and it is felt that the results are well worth recording.

Before going on with a discussion of this manner of treatment of the topic, it is not out of place to say that it has been suggested that an investigation of this subject in a wholly impersonal manner might be a fit project for the W.P.A. or some similar agency. If the totals could be compiled accurately, an intelligent analysis of the resulting figures might be undertaken. This might indicate some steps both possible and practicable towards an adjustment of the present-day situation. Unquestionably such a compilation would be tedious but should be valuable if accurately done. An analysis of the resulting figures would indicate to what degree relief is needed and would probably show up the extent of evasion on the part of those who seek but actually do not need relief. In other words, it is more than likely that the "claim sitters" and "claim hogs" would be set apart very clearly. Finally, with all the information available it should not be difficult to determine whether or not any blanket relief measure is justified.

Various efforts have been made to get an expression from claim owners, not from corporations but from individuals, and the one-, two-, and three-partnership groups, on the matter of continued suspension of requirements. Opinion seems to be about equally divided between those who would have the suspension made effective again this year and those who would oppose any further leniency in this respect. In the opinion of those who have tried to get such an expression by the simplest methods, the results would be about the same if a real questionnaire on the subject could be returned by every claim holder.

Getting back to the county records, it is found that in eleven of the fourteen counties in Arizona affidavits of labor were filed for 5,328 claims, and notices of intention to hold claims under the act suspending the assessment work were filed on 10,409 claims. In a few instances, rather large holdings were recorded. It was thought best to include these so that the picture might contain all the facts obtainable. The most striking example is that of one company which filed its affidavit of labor on 228 claims. No other such group was noted, though there were a great number of instances of more than twenty claims included in one affidavit of labor. The number of exempted claims exceeded the number on which affidavits of labor were filed in all but one county.

Considering the State of Arizona as a whole some 34 per cent of the total number of claims filed on were named in affidavits of labor. There is a considerable range in the tabulation by counties, the percentage of claims on which affidavits of labor were filed varying from 12 per cent to 56 per cent of the total number of unpatented claims mentioned in the records. The counties in which affidavits were filed amounting to more than 30 per cent of the total claims mentioned are those counties in which there is the greatest productive mining activity at present.

Over the State as a whole the claimants belonging to the second group—that is, the corporations, partnerships and the like—hold between 20 and 30 per cent of the claims for which affidavits of labor were filed and just under 20 per cent of the claims exempted. In the county wherein is located the one group of 228 claims mentioned previously, the percentage of claims on which work was done by corporations in compliance with the assessment requirement rose to 41 per cent, but this appears to be an exception.

Two counties, one in which there is at present a considerable productive mining activity, and another in which the mining activities are less extensive, have been selected as representative and for the purpose of making some comparisons. For convenience the counties are designated as A and B. The first comparison is of the total number of claims counted in the records of each county. In County A there were 1,736 claims on which affidavits of labor were filed, against 367 in County B. The claims for which exemption was asked in County A amounted to 2,187; in County B the exempted claims totaled 1,017. In each of these counties a greater number of corporations filed affidavits of labor than asked exemption. Strangely enough, in each county the same number of corporations filed claims for exemption, though on slightly different numbers of claims. In County A, 107 claims were exempted, and in County B, 181 claims were named. The number of corporations involved is so small that it is possible to secure some information regarding the individual corporations. The results of such inquiry, not necessarily final, may be stated as generally indicating that, in County A, most of the corporations had experienced some production, as contrasted with the corporations in County B, which, in the main, have had limited periods of activity and little, if any, production, and whose assets appear to be principally the claims on which they sought exemption.

Following this inquiry further it was discovered that a claim for exemption covering a large block of claims might be filed by different cor-

porations, in lots of twelve claims each, and in addition blocks of six claims each, in the names of individual stockholders. The result is a single block of over 50 claims held under the suspension of assessment act. Further investigation into the activities of these corporations might provide some data for those who would argue in favor of a more rigid enforcement of the annual labor requirements, with no exemptions.

The third group, composed of individuals holding claims, is by far the largest and the most interesting. In County A there were 287 individuals who filed affidavits of labor on 1,016 claims, and 1,070 individuals who claimed exemption on 2,080 claims. Of the 743 individuals in County B who held a total of 1,132 claims, 135 individuals filed affidavits of labor on 296 claims and 585 claimants asked for exemption on 836 claims. It is noticeable that in this third group a large number of claimants are women.

For convenience the owners and numbers of claims held are tabulated in the accompanying table.

Data on Claimants in Two Counties

	Affidavits of Labor				Exemptions			
	Number of Claimants	Number of Claims	% of Total No. of Claims	% Women Claimants	Number of Claimants	Number of Claims	% of Total No. of Claims	% Women Claimants
County A								
Corporations	30	720	41.5	...	20	107	4.9	...
Individuals	287	1,016	58.5	8.6	1,070	2,080	95.1	25.6
County B								
Corporations	23	71	19.3	...	20	181	17.9	...
Individuals	158	367	80.7	5.7	585	836	82.1	11.1

In a recent discussion (*E.&M.J.*, March, 1939) of the suspension of annual labor requirements, A. H. Hubbell stated that "gossip" was current to the effect that the performance of assessment work is sometimes "faked" instead of being performed faithfully. Anyone who has spent much time in any community where mining claims are held by right of location knows that it would be useless to contradict this statement. However, if we ignore the deliberate intent to evade the responsibility, which is clearly apparent in some cases, who will set himself to judge those instances in which the professed compliance with the requirements, though not performed in full, is deemed "just as good"? It is not to be denied that this practice is a serious matter, for it is directly opposed to the two fundamental objectives of the law, development and equal opportunity for all.

Short-cuts, not such a harsh expression as evasion or faking, begin early in the history of a location. Failure to perfect the location or failure to monument the claim before putting it on record are the most common evils. Sometimes some irregularity is practiced for a purpose, such as the writing of a location notice on an aspen tree in a thicket of similar trees as shown in the illustration. Concealing notices in existing monuments is another device of the same character.

The possibilities of faking increase tremendously as soon as the location becomes of record. The subterfuges employed to escape the full annual assessment requirement constitute a considerable bag of tricks. Perhaps one of the most common is the alternate location, year after year, by members of the same family or by one of several partners. Other devices are not so bold, and sometimes the imagination is severely taxed to fit the actual performance to the requirement. Up to the present there seems to be little cure for this condition, and flagrant violations as well as the easy way out have the same standing, except in rare instances where a protest is made.

It is evident that abuses have crept into the exercise of the right to hold claims under the various acts suspending the annual labor requirements. In one instance the records show something over 40 claims in one group originally purported to be owned by one corporation, now exempted at the request of two corporations, the original and a newer one, and the further request of three employees of the original corporation. Another lot of forty-odd claims is held by nine separate notices, over nine different signatures which show a remarkable similarity in the handwriting. Another instrument claims exemption in an "abandoned" claim; one makes his claim for himself and "co-locators, their heirs, administrators and assigns" without naming any such. An inspection of a large number of these notices of intention to hold claims under the suspension act suggests a lot of trouble in the future, for unquestionably the subject of titles to unpatented mining claims is being considerably complicated each time there is granted a suspension of the annual labor requirements.

A location notice was written on this aspen, which stands in a thicket of similar trees

Returning to the records of affidavits of labor and the filed notices of intention to hold claims for the year ended noon, July 1, 1938, is it possible to arrive at any conclusions from the limited data compiled herein? Because the records of small corporations were investigated in only two counties, and because both the number of corporations and the claims held were small, perhaps it is as well to drop them from the discussion at this point. The tabulation indicates that 68.5 per cent of the claims mentioned in the records were duly noticed as being held under the act suspending annual labor requirements. The enumeration in the two representative counties shows that more than three times as many people announced their intention of holding their claims without doing their work, as compared with those who did the work and filed the necessary proofs of labor. Perhaps this is the true measure of the extent to which relief is needed.

On the other hand, it is agreed that each year the number of claims held in this manner is steadily increasing and that such a condition tends to retard mining development. It is also probable that if some of the other and more serious obstacles to mining development could be removed, this condition, in a measure at least, would tend to correct itself

The proper approach to the problem would seem to be by the method indicated here. This brief is not submitted with any claims for completeness or finality. A tabulation of the facts concerning claims held by right of location, together with some pertinent data regarding the claimant, should disclose whether blanket suspensions of annual labor requirements are still justified or whether the law should be modified to meet present-day conditions. By such an inquiry the foundation could be laid for an equitable and intelligent solution of the present problem.

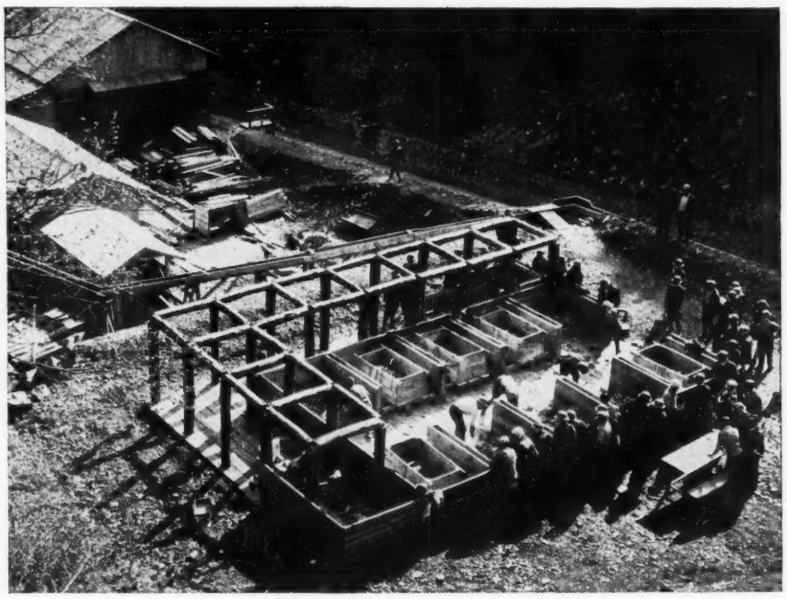
The Japanese Miner Takes Up Shoveling

Round-point, long-handled "muckstick" are replacing time-honored native implements. A school for teaching the art is started

Morris J. Elsing
Consulting Mining Engineer
Tokyo, Japan

UNTIL A YEAR AGO a Western mine shovel was not used in Japan. Mucking in metal mines is done with what is known as a *kassa* and a *mi*. The *kassa* is a triangular-shaped hoe and the *mi* is a pan, made of wood or steel, resembling a dustpan save for having two handles. The mucker scrapes a load of muck on to the *mi* with his *kassa*. Then laying his *kassa* aside, he picks up the *mi* and empties it into the car or chute. The operation is slow and exceedingly tiring, so I decided to try to introduce the round-point long-handled mine shovel. First I made a search through the stock of several of the most important shovel manufacturers in Tokyo to see if they had a shovel that we could use. There were plenty of D-handled spades and some D-handled scoops, but no shovels. I was informed that the typical Western mine shovel was unknown in Japan.

A cable to Arizona eventually brought two samples of the good old long-handled shovel. Needless to say, my message created considerable perplexity and speculation on the part of some as to what I was doing and why. After several weeks, my shovels arrived and, after passing through the customs, were turned over to the shovel manufacturer. After longer delays I received my first batch of Japanese-made round-point long-handled mine shovels.



Outdoor school for mine shovelers started by the author at Taro mine, Iwate Prefecture, Japan. The new art has become popular locally

The next problem was to introduce shoveling. In the meantime I had brought J. T. Verant to Japan from Bisbee, Ariz., to help me with this task and to introduce various new methods of mining.

The first step was to start an outdoor shoveling school. For this we used a large platform with five parallel stalls. In each of these stalls there was a bottomless box which represented a mine car. This car was filled alternately at each end of the stall. A square-set gangway was built around the outside edge of the platform. This represented a runway in a square-set stope with a right-angle turn. Here, instruction was given in shoveling into wheelbarrows and wheeling around this turn.

Every phase of shoveling was carefully gone into; the shoveler's stance, his body movements, his arm movements, his timing were all as thoroughly checked as if it were a golf lesson. He was instructed in right-hand shoveling, in left-hand shoveling, in the long throw and in wheelbarrow shoveling. There were follow-up lessons in the mine.

The mine employs about 700 men underground, and little by little we have been replacing the *kassa* and *mi* with the pick and shovel. Many of the men have become expert, and I decided it was time to show what could be done with shovels. We are using the sub-level caving method of mining with hand-shoveling into cars. We chose one of our best muckers and arranged things so that he would do nothing but shovel during his 7½ hours underground. We selected two caving crosscuts for the shoveling. The ore was a slate impregnated with cupriferous pyrite and was fairly heavy. The shoveler loaded the car and a trammer trammed it from the caving face and another man brought in an empty car. Mucking was done into a standard revolving end-dump steel mine car, with a capacity of 18.3 cu.ft. The first seven cars were mucked from the rough and all other cars from plank flooring. The shoveler filled 32 cars in the morning and 19.6 cars in the afternoon. A complete time study of the shift's work was recorded. The items tabulated are of the most interest and are exceedingly satisfactory.

The habits and customs of a thousand years are difficult to break; and so once in a while we find men who persist in using their *kassa* and *mi* instead of a shovel, but the great majority of the miners realize the effi-

Time Study of Shoveling

Taro Mine, Iwate Prefecture, Japan

Number of cars mucked	51.6
Metric tons mucked	58.0
Short tons mucked	64.0
Average number of shovels per car	150
Total number of shovels	7,740
Average number of shovels per metric ton	133

	Hours	Minutes	Seconds
Total mucking time	5	38	25
Mucking time per car	0	6	33
Fastest mucking time per car	0	5	16
Mucking time per metric ton	0	5	50
Total resting time	1	46	55
Average resting time between cars	0	2	4
Shortest resting time between cars	0	0	38
Resting time per metric ton	0	1	50
Total time	7	25	20
Total time per car	0	8	37
Total time per metric ton	0	7	40
Lunch	0	34	40

Some Trends in the Treatment of Gold Ores In Canada

An interpretation of the changes and the progress made

Henry Hanson
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MY PURPOSE in preparing this review is to direct attention to certain changes that have been brought about in the treatment of gold ores in Canada and to interpret them. At the same time I wish to point out present trends in the effort to obtain best results as to recovery and cost. The successive steps in operation will be discussed briefly, without, however, entering into detailed descriptions of flowsheets.

Crushing—The tendency in recent years has been to deliver a finer product to the grinding equipment. This is apparently due to three factors: (1) Development of more efficient crushing equipment. (2) Elimination of the dust nuisance incident to dry crushing, by the different types of dust collectors. (3) The economy in dry crushing to ¼ in. The production of finer feed for the grinding mills has been accomplished by introducing a third step in dry crushing. Generally speaking, the primary crushing is done in jaw crushers. In several of the large mines this step is performed underground. Reduction of the ore when reduced to 6-in. size, or smaller, facilitates subsequent handling. In the intermediate reduction from 6 in. to 1 in. or 1½ in., crushers of the gyratory type are employed. In the final stage of reduction, use is made of the Short-head cone crusher or rolls, and the final product is usually maintained at ¼ in. or ⅜ in. size, by means of screens which return the oversize. In small-scale operation it is quite possible to obtain approximate results in two-stage crushing. At the 1,000-ton plant of the Young-Davidson a ⅜-in. product is obtained by two-stage crushing using a jaw crusher followed by a Symons cone crusher. Here the Hollinger practice of taking out a concentrate by mechanical tables is followed, the concentrates being reground to a fineness suitable for a maximum economic recovery. This method is more positive than that of building up concentrate by intensive circulation in closed circuit, tending toward selective grinding of the sulphides.

Grinding—As the cost of fine grinding is a large item, not only in the initial cost of equipment but also in respect to those constants such as power, grinding media, and liners, much time and thought, as well as experimentation, have been given to the development of the most efficient equipment for accomplishing it and for ascertaining what is the most effective control in the operation of this equipment. It is impossible to arrive at any absolute standards applicable to all plants, inasmuch as the degree of fineness required, the scale of operation, the character of ore, and the recovery method will be factors to be considered before a decision can be made as to size and type of grinding units. An important point perhaps not fully realized by all mill men is to determine the best speed of the mill, the size and load of grinding media giving the maximum result, the proper ratio of moisture to solids, and the most efficient circulating load. Other factors affecting the capacity of a mill are the type of discharge and the efficiency of the classifier in eliminating that part of the ore already ground to the required fineness for subsequent treatment. The type of liner also may play a part in the efficiency of the mill.

As a general practice, it would appear that where very fine grinding is essential, grinding in at least two stages best answers the purpose and that in mills requiring from 65 to 80 per cent minus-200 mesh, single-stage grinding has been adopted in recent new plants. Advantages of single-stage grinding are at least twofold: less space is required and less attention is needed. Where one large unit replaces two smaller grinding units, there should be a substantial saving in power for the same unit of grinding performance. With this saving in power it would be reasonable to expect some saving in the cost of grinding media and liners, as the wear of these normally is related directly to the power expended under like operating control.

Thus in Porcupine, where fine grinding of the total product is not necessary, the trend has been to single-stage grinding as done at the McIntyre, Coniaurum, and other plants. The Hollinger, after carrying on extensive experiments, found it economical to convert the company's rod mills into ball mills, using open-grate discharge in closed circuit with classifiers, eliminating all secondary mills except concentrate regrinders. The practice, once prevalent, of running primary mills in open circuit has largely disappeared, except at the Dome for metallurgical reasons, inasmuch as this practice did not give the mills a chance to work up to capacity, as is the case where the return of classifier oversize to the mill increases the circulating load and improves the mill performance with respect to power expended. In some instances where two-stage grinding is employed, it has been found advantageous to bypass part of the oversize of the secondary grinding mill to the primary grinder, or vice versa, to keep the two units in proper balance. In such recently built plants as the Kerr-Addison and East Malartic, large single-stage grinding units were adopted, which is fairly indicative of the present trend. In fact, the Marcy slogan of 1914, "one easy step," is more applicable today because now a ¼-in. product can be delivered to the mill instead of a 1½-in. product, as at that time. With finer feed going to the mills, smaller balls can be used, offering greater grinding surfaces. The conical mill has the advantage of classifying the balls, which normally should give it a larger efficient grinding range. Whether this is sufficient to counteract the advantages shown by open-grate discharge of cylindrical mills, as demonstrated by experimentation at the Hollinger and Sylvanite plants, remains an open question.

At Kirkland Lake the ore is of

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ciency of the shovel and the management is enthusiastic about its use. The Government has made a moving picture of shoveling, and this is being sent to various mining companies. It is my opinion that shoveling will eventually be introduced into all of the metal mines of Japan, and that thereby shoveling efficiency can be doubled.

such a character that very fine grinding now prevails in all the mills. The fact that the fine grinding now practiced was a slow and gradual development is perhaps due largely to lack of suitable equipment for solving the problem rather than to a lack of knowledge of this need. The development of the bowl classifier and its installation at these mills played an important part in solving the grinding problem and bringing about recoveries comparable to those secured at other Ontario mines operating on ores much less rebellious. Other factors contributing to this satisfactory solution will be discussed subsequently. Two-stage grinding is used at all the Kirkland Lake mines. The primary mill takes for the most part a ¼-in. feed and works in closed circuit with a classifier of the standard type; the secondary grinders are usually longer and of smaller diameter, use smaller balls than those in the primary mills, and work in closed circuit with bowl classifiers. The finished classifier overflow is practically all —200 mesh and 80 to 90 per cent —325 mesh.

Values in Old Dumps

As the present rather low tailing was not always obtained, one may be pardoned for stopping to think whether the values delivered onto the large tailing dumps built during the years of high residues are still there or whether time and the small amount of cyanide retained have materially lowered them. It would seem likely that the rebellious iron pyrites would still hold fast to their gold values, and also that a middling product made before present-day fine grinding became a fixed practice would interest the experimenter.

Recovery of Coarse Free Gold—The old saying "take out the free gold as soon as possible" was given a severe jolt when all-sliming or fine-grinding became prevailing practice. Today, however, provision is made in many plants to capture at least the coarse free gold liberated in the grinding. At the Dome, where originally the silver-plated copper plates were used, these have given way to blankets. At the McIntyre, the discharge from the tube mill goes to single primary cells, which take off a very high-grade froth, but provision is also made in the bottom of the cells to trap coarse gold; this prevents high values from being built up in the mill-and-classifier circuit, as does the blanket practice at the Dome.

At the Hollinger, the grinding is done in cyanide solution and the classifier overflow goes to mechanical tables, where a concentrate is taken out containing a large percentage of the value undissolved at that point in the treatment. These concentrates are reground with cyanide of suitable strength to a point where the gold values are released. At Little Long Lac mine, grinding is done in water and most of the liberated gold is recovered on blankets. At the Madsen plant, a recent addition to the list of producers, the ball-mill discharge goes to a jig, as does the tube-mill discharge. The tailing from these jigs can be sent to the classifier in close circuit with the primary ball mill, which is a departure from the usual practice. If jigs will take free gold out as well as do blankets, they should gain a permanent place in new plants, especially those where the condition of the ore makes grinding in water economically desirable. At the Homestake, the outstanding plant in the United States, the chuck block and silver-plated copper plate have disappeared and the free gold is recovered by feeding mercury to the grinding mills and having the discharge from these mills go into Clark-Todd amalgamators, consisting of a labyrinth of copper plate baffles also containing trays of silver-plated copper where the amalgam is deposited. These amalgamators are covered with screens under lock and key and are opened periodically only under proper supervision. This appears to be a simple clean method of recovering the free gold. It also has the advantage of preventing large values from building up in the classifiers. However, some amalgam is certain to collect between and under the liners, which is recoverable only when the liners are renewed. Several smaller plants in Quebec, Ontario, and elsewhere are recovering a substantial part of the value in the ore as free gold either from traps, blankets, or jigs, which is later amalgamated in barrels.

Thickening—The chief improvement in thickeners has been the perfecting of the tray thickeners which have come into common use. These have one tray and sometimes two trays, in the same tank, which greatly lessens the space requirements, which is important in reducing the size of the mill building. However, the countercurrent decantation method has been largely supplanted by reason of the greater use made of filters of the drum and disk type. Some engineers still advocate the dilution of solution values by partial countercurrent decantation before final filtration, in that way obviating the necessity of double filtration. Other mill men prefer double filtration on the ground that it takes less space and is more positive in reducing dissolved values in the final filter residues. Unless it can be shown that substantial values are dissolved in the partial countercurrent system, which in most cases seems unlikely, the double filtration should show up to advantage in this competition.

Agitation—In plants grinding in cyanide solution, normally over 70 per cent of the gold values have been dissolved before the pulp finds its way to the agitators. The agitators most commonly used are those of the Dorr type and the conical-bottom pachucas. Both of these types are in use at the Hollinger and, from reports, both seem equally efficient metallurgically. Other types have recently been adopted in some plants.

Oxygen Deficiency

Where the solution in the pulp is deficient in oxygen, it is doubtful if this deficiency can be made up by the air-agitation in either of these methods. At all Kirkland Lake mills, two separate periods of agitation, and in some cases more, were adopted. After primary agitation the pulp is filtered, repulped with fresh solution, and delivered to the second set of agitators, the purpose being to remedy the deficiency in oxygen. This is accomplished first by drawing air into the minute interstitial spaces in the filter cake and secondly by repulping the cake with solution highly saturated with oxygen. This system of double, or more, agitation, accompanied by very fine grinding, has been an important factor in a most creditable achievement at Kirkland Lake in increasing recovery from a somewhat baffling and refractory ore. In addition to fine grinding and two-stage agitation, some credit is due to flotation. At Wright-Hargreaves, a high-grade concentrate is floated from the cyanide tailing, representing less than 1 per cent of the ore in weight, and is given special treatment. At the Lake Shore, experiments have been made in roasting a flotation concentrate, including pyrites. The pyrites in Kirkland Lake ores is particularly rebellious and only roasting seems to be able to condition it to a point where the values can be dissolved. Perhaps the most exhaustive experimentation ever attempted on a gold ore was that carried on by Lake Shore in determining the values in different sizes at various stages of treatment, in isolating the various minerals for microscopic examination and experimentation with reagents, and in determining time factors in agitation. In this work the Infrasizer, the Superpanner, and the microscope played important parts.

Flotation—As yet, flotation has made no serious inroads into the field dominated by cyaniding of gold ores. There are two types of ore that lend themselves especially to it. One is the ore in which the values are intimately associated with pyrites and which yields a high recovery when treated by flotation, as, for example, the McIntyre ore. The second type is the rebellious ore, the object in treating which is to reduce the tonnage to be conditioned or to put it into the state where the values can be extracted, as the Beattie ore, the arsenical north-zone ore of the Hard Rock mine, and

the MacLeod. It must not be assumed that flotation is a cure-all. Most gold ores give up their values in response to standard cyanide practice, but at times, due to the disintegration or the oxidation of certain sulphides, the cyanide solution may become stagnant or inactive. This condition should not lead to abandoning the process lightly, when measures might often be taken that would surmount the difficulties.

Special Treatment—Some ore does not lend itself to grinding in cyanide solution. This fact was demonstrated when the Dome, after the mill was rebuilt following the fire, tried out grinding in cyanide solution as was done in other plants in the Porcupine camp. The practice was soon discontinued because of high tailings losses. It was learned that certain unstable sulphides, pyrrhotite in particular, oxidized or disintegrated during the period of grinding and agitation. In oxidizing they absorb or rob oxygen from the solution in the pulp. When the oxygen in the pulp has been reduced to a certain point, solvent action practically ceases. Cyanide pulps seem incapable of absorbing any oxygen, or more than a very little, from the air used in agitation. It is possible that discharging the pulp on a very fine screen and blowing a jet of air on the finely divided streams would be more effective.

The Dome resumed grinding in water and introduced what is now well known as the pre-aëration period where the thickened alkaline pulp is given an agitation with air, the moisture in the pulp being water, the purpose of this aëration no doubt being to hasten the oxidation of those unstable sulphides and other compounds that withdraw oxygen from the solution in the pulp. It would hardly seem likely that complete oxidation could be obtained in a short agitating period. Whether some chemical may be applied, either to expedite the oxidation or to seal the unstable compounds, offers a fertile field for the investigator. At the Homestake, the need of constantly replenishing oxygen in both sand and slime treatment prevented experimenters from introducing cyanidation there at an earlier date. The success at both the sand-leaching plants and at the slime plants was wholly dependent on periodic aërations. In the leaching vats, the water or solution was drained off through the filter bottom and a current of low-pressure air was applied under the filter so that it worked up through the sand. In the slime presses, the moisture in the filter cake was displaced by air, the latter filling all interstitial spaces before solution was applied to the cake. In *E.&M.J.*, Oct. 12, 1931, Allan J. Clark, metallurgist for the Homestake, comments as follows:

"Among the minerals containing iron in the ferrous state are pyrrhotite, chlorite, cummingtonite, and a dolomitic carbonate. Some of these carry as much as 30 per cent Fe. These compounds oxidize rapidly or perhaps it would be more precise to say steadily, as the action seemingly continues throughout the treatment cycle. In oxidizing they generate cyanicides and withdraw oxygen from the working solution."

I want to emphasize the words "oxidize steadily" in the foregoing excerpt because around that fact the whole treatment scheme of the Homestake was built. It is doubtful if the pre-aëration now used at the Dome and other Canadian plants would have solved the Homestake problem. (No amount of agitation of the cyanide pulp with air in pachuca tanks seemed to have a noticeable effect in promoting the solvent action.)

Classification—The Akins classifier has been greatly improved mechanically and has found favor with a number of engineers and operators in the primary-grinding circuit or in single-stage grinding. Where very fine grinding is required, however, the Dorr bowl classifier is largely used.

Precipitation—Merrill-Crowe precipitation has more than kept pace with the mechanical and metallurgical improvement in other branches of the cyanide process. The simultaneous clarification, de-aëration and precipitation, together with the use of filter bags, filter leaves, and filter presses to fit any particular condition, has made the process more elastic. Better clarification has been stressed. The results have been a reduction in zinc used, and the production of a higher grade precipitate, which has simplified refining and reduced its cost materially.

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Copper in New Zealand

THOUGH copper minerals have been found at many places in New Zealand and copper ore was the first material to be mined there, the total output has been small—in all 5,032 tons of ore, valued at £109,878, according to J. Henderson, Director of New Zealand Geological Survey. Most of this was mined over 70 years ago. During the present century only a few tons has been extracted, despite much prospecting.

In many deposits the copper minerals have been derived from magmas. Surface waters seem to have concentrated some orebodies, and fahlbands occur.

The Hauraki Peninsular and the range continuing southward almost to Rotorua are built up of volcanic flows and breccias resting on folded sediments. At many points emanations from the underlying magma have altered the rocks and formed orebodies. From Great Barrier Island 2,323 tons of copper ore, concentrated probably by hand picking from 50,000 tons of rock, was shipped over 60 years ago. The copper content was probably about 15 per cent.

Near Pupuke, in North Auckland, there are small copper deposits consisting chiefly of pyrite and marcasite, together with chalcopyrite and other copper minerals. A few tons has been shipped containing about 5 per cent copper, 0.5 oz. silver, and a few grains of gold. In South Island deposits of copper ore occur, consisting of pockets and lenses in crushed serpentine zones. Here four attempts have been made to take out ore. At one point a crushed zone has been explored by adits to 500 ft. depth. Here a lean pyrrhotite replacing the high-grade copper minerals is considered the primary ore. It contains less than 1 per cent of copper, 0.5 per cent of nickel, and traces of cobalt, gold, and silver. In the same region pegmatitic veins carrying a little copper and molybdenum were prospected, following their discovery in 1906. In general they contain less than 1 per cent of copper, a trace of gold, and a small amount of silver per ton. To date no mine has been opened.

Copper ores of the red-bed type have been found at many points, the best known being on Kawau Island, 30 miles north of Auckland; in the Raukotere basin 65 miles north of Gisborne; and near Maharahara, 85 miles northeast of Wellington. Mining began at Kawau in the 40's and resulted in a production of £60,000 worth of ore. An attempt was made to reopen the mine in 1900 but there was no production. In the Raukotere basin iron pyrites occurs in masses in graywacke. The pyrite appears to contain less than 1 per cent of copper, though there are richer patches. At Maharahara a deposit found in 1887 has been prospected extensively without revealing ore in payable amount. The minerals are chalcopyrite and copper-bearing pyrite. The pyrite contains about 0.5 per cent copper, a pennyweight of silver, and a trace of gold.

Three copper prospects are known in the southern part of South Island, all interbedded in schists. Despite prospecting, little work has been done.

In summary, none of the many copper deposits in New Zealand has proved of commercial value and their chances are not promising. The deposit on Kawau Island has yielded the largest return.

Mining at

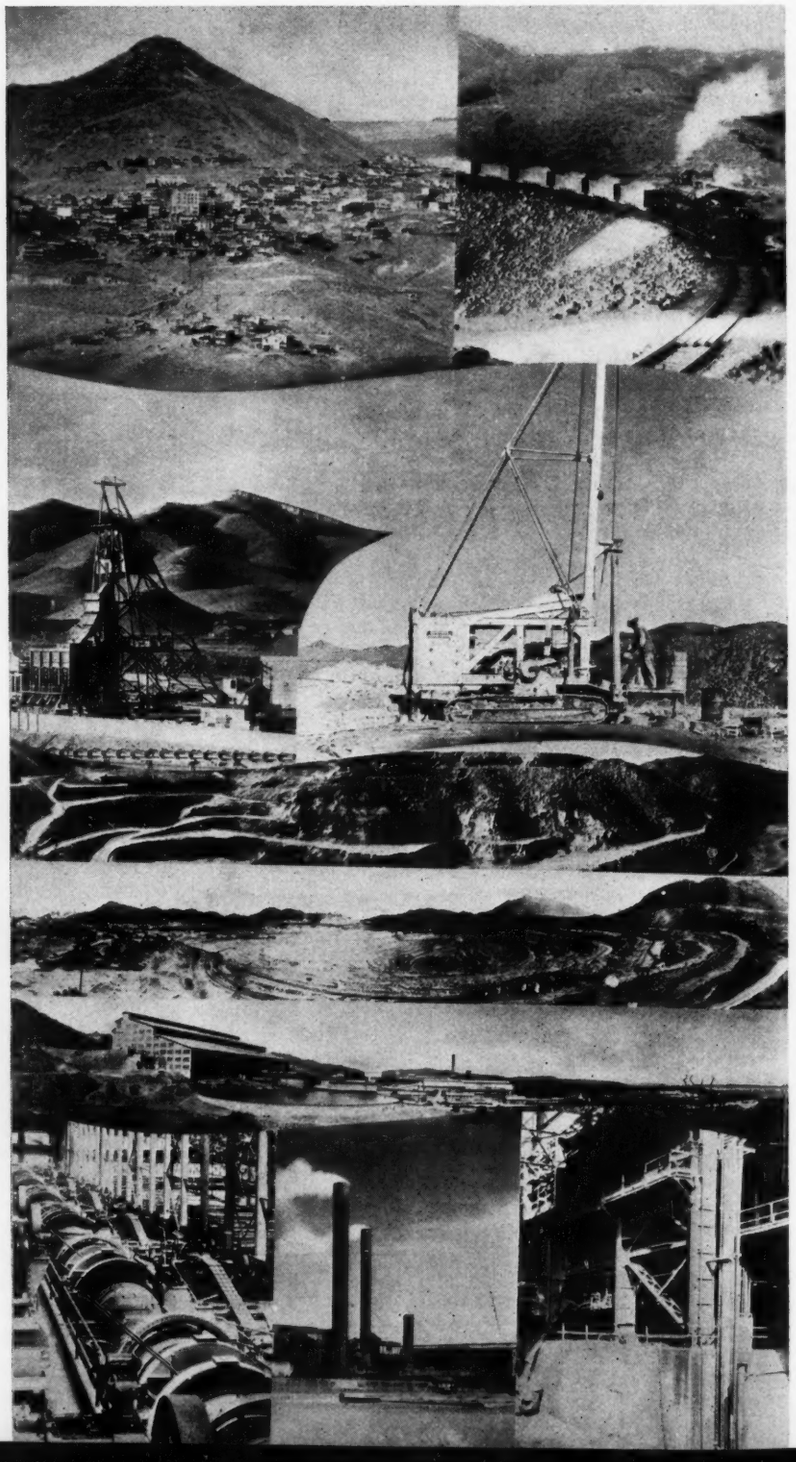
Visitors to the Copper and Brass Industry's exhibit in the Metals Building are introduced, by a hidden voice, to the copper atom symbolized at the left. Pillars with copper sheets divide sections of the exhibits that contain models and photomurals of all phases of the industry

Arizona's leading industry, copper mining, is exhibited in its State Building by the series of photomurals below

Ester Henderson, Tucson, Ariz.

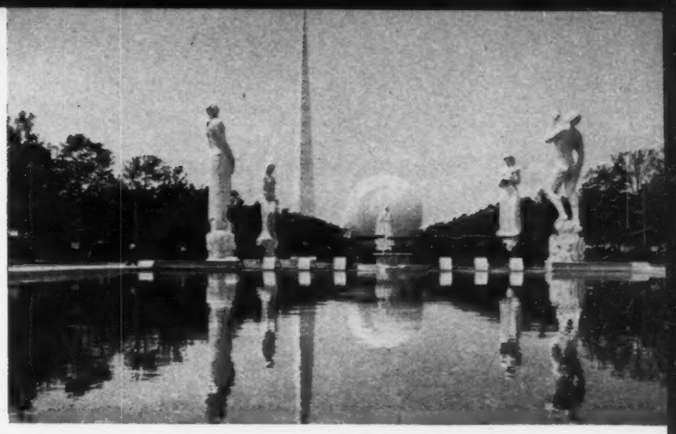
Interest here centers in the model showing copper mining by the open-pit method. To the left a window display contains copper ores and shows a phase of underground mining

Minnesota's "Grand Canyon" is the name given to this diorama of the huge Hull-Rust pit of the Oliver Iron Mining Company at the United States Steel Subsidiaries Exhibits

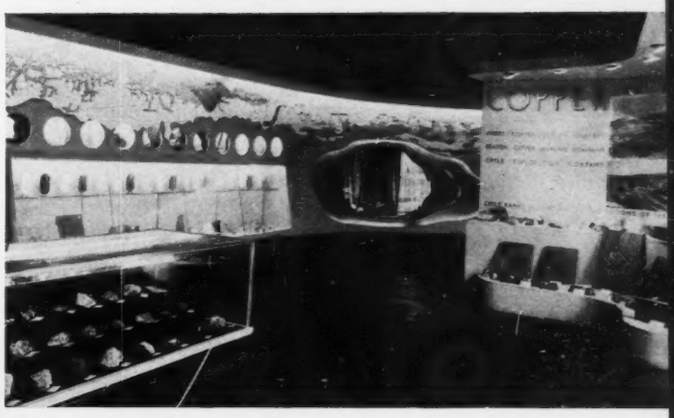


the World's Fair

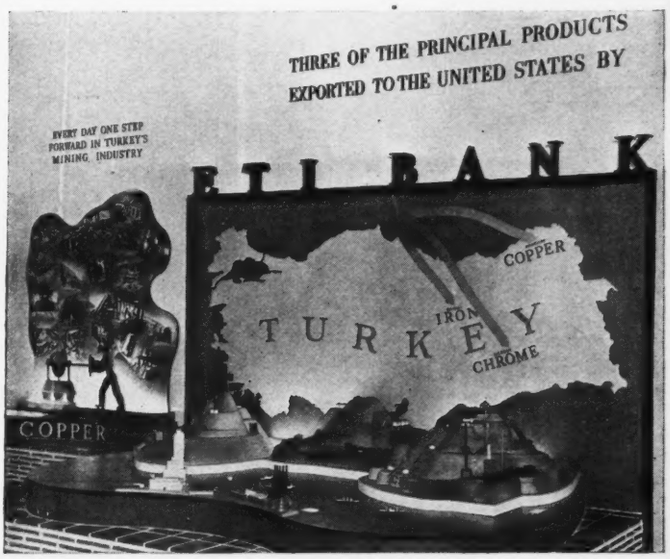
NATIONS, States and industries seek to enlighten the visitor to the New York World's Fair on their respective contribution toward the theme "The World of Tomorrow." In the Metals Building, near the 700-ft. Trylon, the story of copper mining is portrayed and products made of copper are attractively displayed. Iron mining and dioramas of steel making share the interest of thousands of visitors daily to this building. Along the Court of Peace, small foreign nations portray their achievements in development of their mineral resources. Arizona, Utah, Washington, among others, in the Court of States, give recognition to their mining industry in the form of photomurals, dioramas, and mineral exhibits. Attractive and colorful buildings contain a wealth of free information on this nation's scientific research and what industry is doing for America.



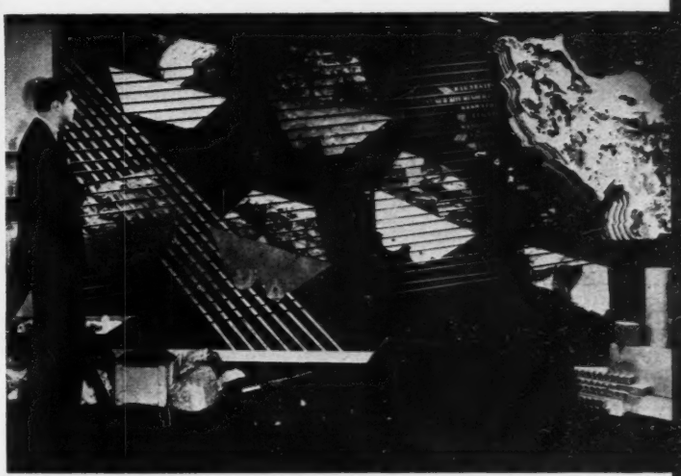
From the Lagoon of Nations the vista takes in the impressive sculptured group representing freedom of speech, freedom of assembly, freedom of the press, and freedom of religion. In the background—the 700-ft. Trylon and Perisphere, the theme center of the Fair



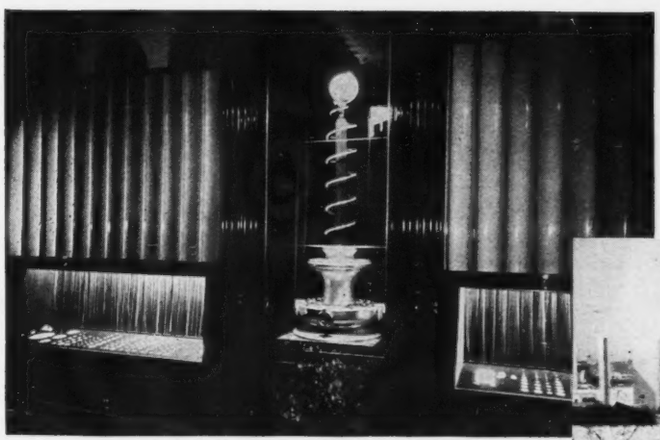
Mineral zones of Chile are indicated on the long map of the country above ore specimens. Copper producers display their ores and variously shaped ingots from the smelters in that country



Turkey's expanding mining industry holds an important position in that nation's future development. The country is now one of the world's leading exporters of chrome ore

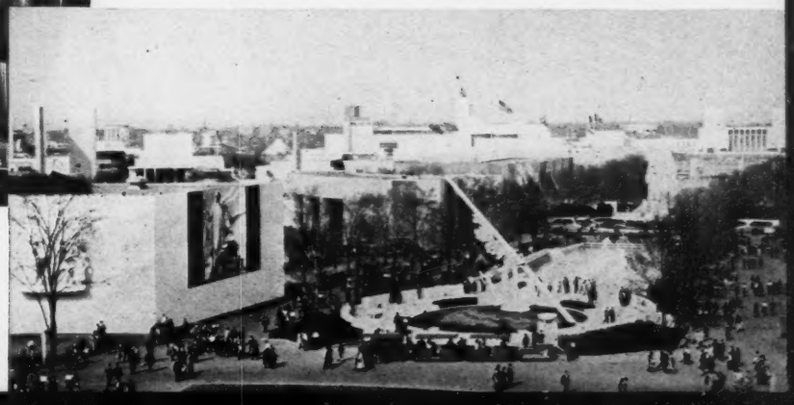


Little Yugoslavia takes an interest in displaying evidence of her extensive mineral resources. On the right a map shows locations of mining areas. The small mine cars contain ore



Diamonds mined in South Africa dazzle visitors to the House of Jewels. The center spiral, set with diamonds, revolves slowly and portrays the ascent of the stones to the earth's surface indicated on the diamond-studded globe at the top. Parcels of graded stones are displayed in the windows on each side

Constitution Mall with the largest sun dial in the world in the foreground and the United States Building in the background makes this picturesque view from the ramp of the Perisphere



Spherical-bottom Skip Self-cleaning

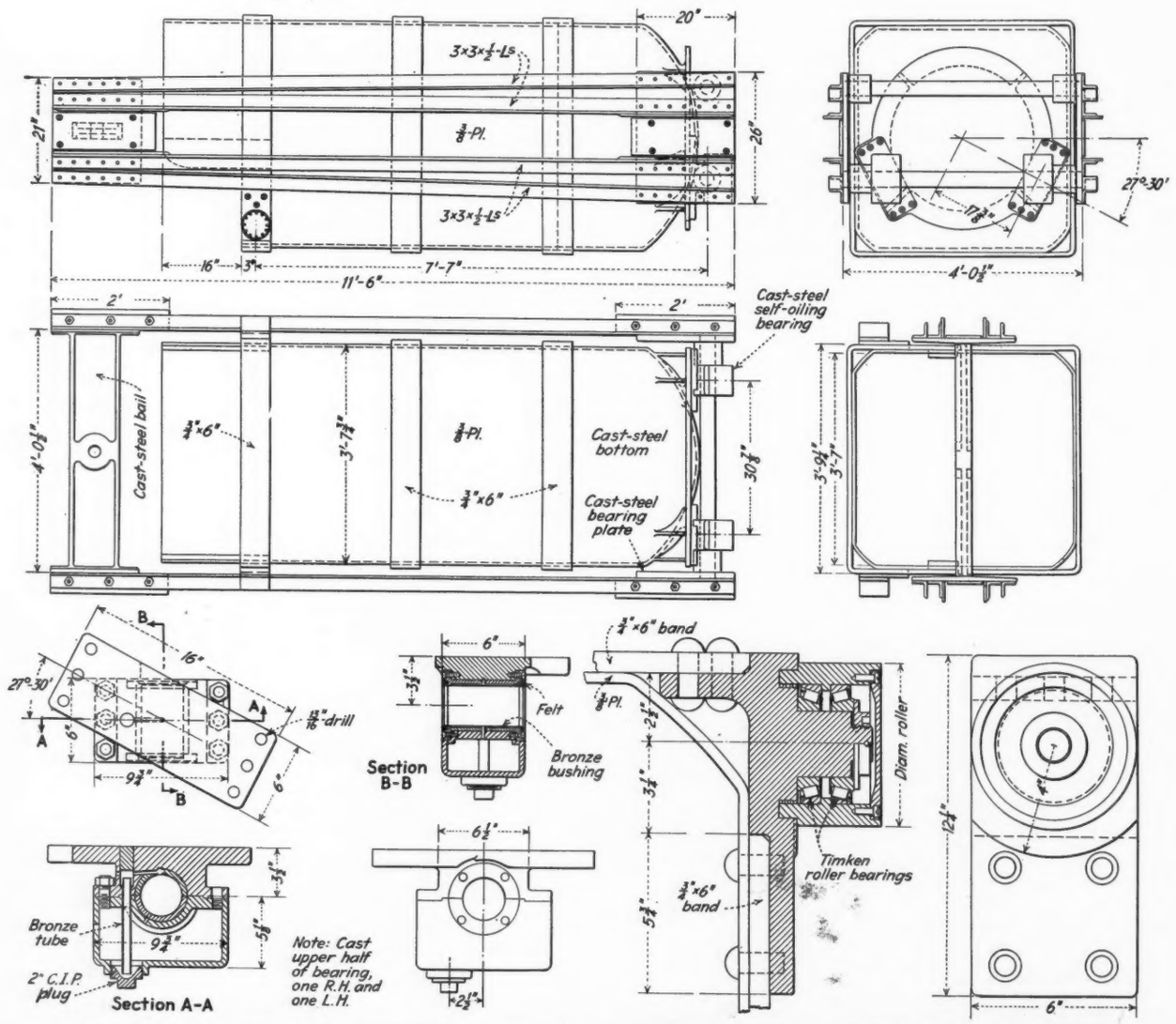
Designed in Cleveland-Cliffs shops, it is also lighter and stronger than older type

L. C. Moore
Chief Mechanical Engineer
Cleveland-Cliffs Iron Company
Ishpeming, Mich.

SOME TIME AGO, O. D. McClure, then chief mechanical engineer of the Cleveland-Cliffs Iron Company, designed a 5-ton skip, made of alloy-steel plate and having a cast-steel spherical bottom, that has proven much better than any skip used by the company in the past. Its construction is shown in the accompanying drawings. The superior points of the design are as follows:

The spherical bottom eliminates the trouble caused by soft, sticky iron ore packing into the corners when the skip is loaded and having to be cleaned out frequently with a pick or a bar. Some operators at other mines have avoided this difficulty by using loosely fastened sections of 1¼-in. diameter steam-shovel chains in the skip bottom, which shook the bottom ore loose when the skip turned upside down. Such chains were successful in skips handling hard ore on the Vermilion range in Minnesota, but, when they were tried on the soft hematite of the mines of the Marquette range, the painty material seemed to pack more tightly around the chains and to give more trouble than was had without them. With the spherical bottom, in contrast, even the stickiest ores slide out, thus eliminating the costly stops for cleaning, perhaps at times when the skips should be operating to secure maximum production.

In weight the 94-cu.ft. skip is approximately 6,000 lb., as compared with over 7,000 lb. in the older type of skip. This reduction in weight and the greater strength make up for the advantages secured in building skips



The all-welded steel skip designed by O. D. McClure for the mines of the Cleveland-Cliffs Iron Company in the Lake Superior Iron Country. The spherical bottom affords several advantages. Accompanying details show the skip-axle bearing and the anti-friction-bearing dump roller

of light metal. In fact, the alloy-steel-plate skip has proven more economical than one constructed of aluminum. The cast-steel bottom is welded to the alloy-steel-plate sides. The ¾x6-in. stiffening bands are forged with square corners, and the plate sides form a fillet at the corner, as shown at "A." This makes a stronger welded construction and gives the ore less chance to pack at this point. The radius of the spherical bottom is half the distance between diagonal corners of the skip box. This proportioning not only helps in cleaning the skip but permits the bottom to form up better with the side plates. Riveting is used only in attaching the dump rollers and bottom brackets while the axle bearings are attached with studs.

The bottom bracket-bearing plates are of cast steel machined to secure perfect alignment. In the old design of twenty years ago, and still being used by some companies, the skip rests on a cradle made up of an I-beam on one side and a round axle on the other. This beam and axle were attached to individual steel brackets riveted to the side angles engaging the skip guides. The drawbacks in using this construction were two: first, when the skip was hoisted through the shaft, ore would drop on top of the I-beam and a piece would work along until it formed a wedge between the skip and the I-beam, tipping the former until finally its top edge caught on the shaft sets. In the new design, here described, where the I-beam is replaced with a round bar, as dirt drops on top it is impossible for it to form a wedge, there is always a metal to metal bearing and the skip rides in a vertical position. Next, with the skips of the old type the twisting and banging received by the lower section of the cradle loosened the rivets slowly so that the skip cradle had to be rebuilt about every six months. In the new skip the supporting bars, which are of Agathon steel 3 in. in diameter, are forced under several tons' pressure into the one-piece cast-steel side-frames, making such rigid construction that the skip has operated over two years and still shows no sign of weakness.

The cast-steel bearings attaching the skip to the cradle are of a new design that provides for placing a few drops of oil on the bearing from the oil cellar in the base every time the skip dumps, thus eliminating practically all wear at this point. These bearings are built to exclude the dirt and need oiling only about once a month.

The bail at the top is of cast steel and is as rigid as a forging and costs less money. The ends are machined on this for true alignment.

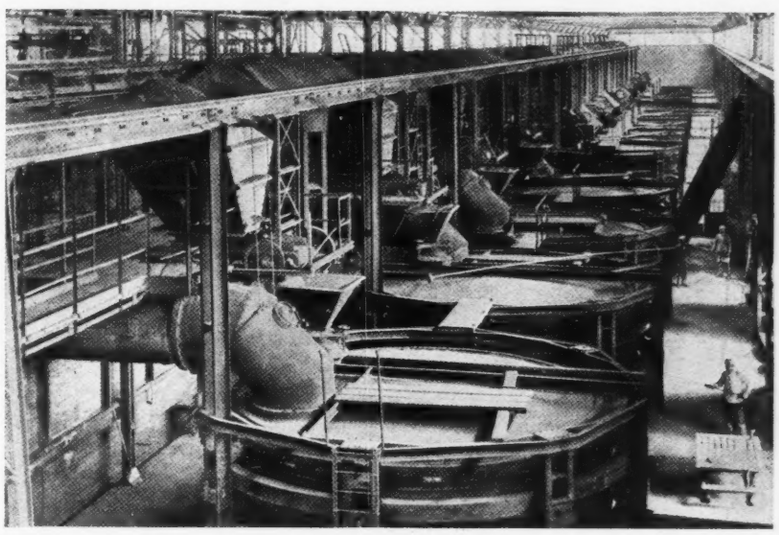
Dump rollers are ball-bearing, thus eliminating wear and trouble at this point. The horns engaging the rollers attached to the dump plates are welded to a plate extending around the skip box that not only strengthens the horns but stops spillage down the shaft when the skips are overloaded.

The design is such that this 5-ton size can be enlarged to one of 8 tons without sacrificing any of the improvements just cited. The Negaunee, Athens, and Maas mines of Cleveland-Cliffs Iron Company are now using this skip and have found no weakness in it so far. Its design and the record of its operation have so impressed the Lake Shore Engine Works, Marquette, Mich., that they now manufacture it in various sizes for other companies.

Roasting Zinc Blende In Spirlet Furnace

Prayon Metallurgical Company in Belgium claims 20-metric-ton unit recently introduced gives excellent results

EFFORTS to solve the problems presented by the known defects of various multiple-hearth furnaces used in roasting zinc blende have led to the development of the 20-ton Spirlet furnace, which is the result of extensive experiments made by the Société Anonyme Metallurgique de Prayon, of Trooz, Belgium. According to the company, the Spirlet furnace, consisting of a series of independent hearths, alternately stationary and rotating, is particularly easy to install. The play provided in the hearths reduces to a minimum their likelihood of becoming stuck. A furnace may be completely renovated in one day; the firing period is short because of the small volume of refractory material to be heated. As a result, four days are sufficient to put a renovated furnace back into operation.



Spirlet furnaces in operation in a plant on the Continent. The photograph was supplied by Soc. Anon. Metallurgique de Prayon, Trooz, Belgium

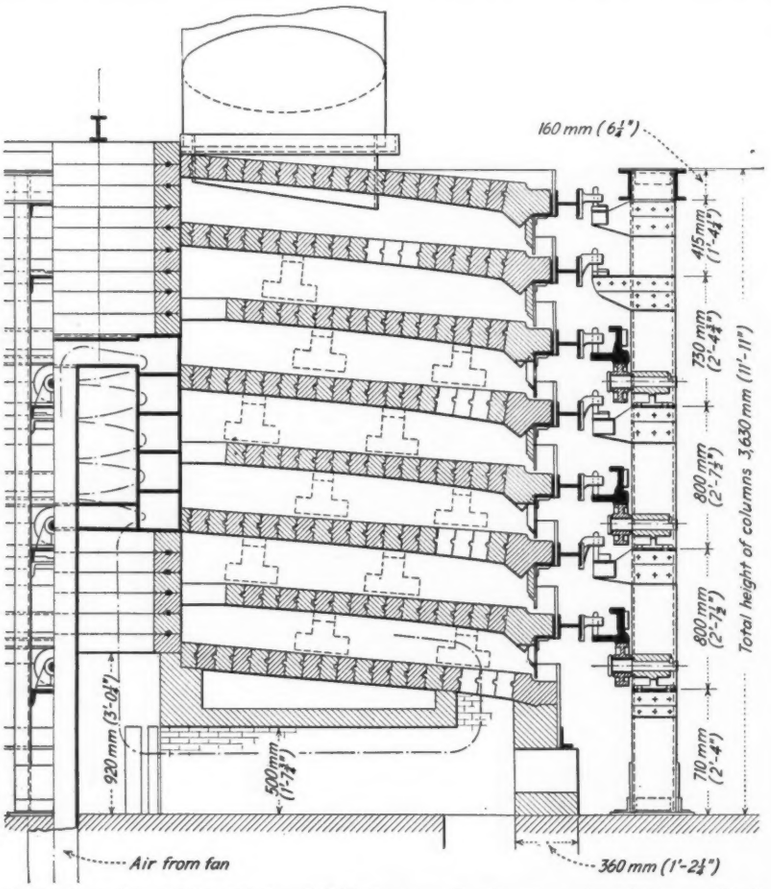
The hearths are closely spaced. The reduced height of the gas chambers between the hearths assures excellent contact between ore and roasting gas, thus permitting a desulphurization which is almost complete. A high content of sulphur dioxide in the gas also is obtained. Refractory steel supports are suitably placed in the hearths to hold the rabbling teeth, the number and dimensions of which may be easily changed, while in motion, in such manner as to obtain for each stage an optimum height of evenly distributed ore.

The operating temperature of the furnace is remarkably uniform in view of the large amount of material treated. Hand manipulation is so reduced that a single workman without special training can take care of a furnace treating 20 metric tons of crude blende daily. Maintenance personnel is also reduced to one man, who can always take care of a plant of ten or twelve furnaces.

The 20-ton Spirlet furnace has six

rotating hearths instead of four, as in the ordinary type. Hot gases generated by the heat of reaction in the lower part of the furnace are conducted through a central tube to preheat the incoming ore in the upper hearths, thus permitting better temperature distribution and extending the zone of desulphurization.

At the beginning of the experiments, the central tube was a flanged tube of sheet- or cast-metal crossing the furnace from side to side, but this now consists of a conduit designed so as to cause the cooling air to traverse a helicoidal channel. Position and dimensions of the conduit are carefully selected so as to obtain a maximum cooling effect at the hottest stages of the furnace. The conduit is placed between two trimmed courses of firebrick as shown in the accompanying sketch.



Vertical section of 20-metric ton Spirlet furnace. The hearths, alternately, are fixed and rotating

The high temperature of the upper hearths permits the volatilization of a considerable amount of the lead contained in the blende. If each of the furnaces is followed by a group of suitable "electro-filters," the lead may be collected in a rich dust yielding a valuable recovery. The electro-filters are of the tubular type; their dimensions are such that the maximum rate of passage of the gas is of the order of 50 cm. per second. The high-tension current is conducted by a framework to wires which are hung with weights on the ends to serve as ballast. These wires are placed in the space provided between two or three concentric sheet-metal cylinders which are suitably separated and grounded.

These electro-filters are utilized to some extent as finishing equipment. Specifically, between the furnace and the electro-filter there is placed a cyclone at the point where a large portion of the dust is deposited. This does not contain much lead, and it is passed back into the furnace charge. Draft is regulated by a variable-speed fan placed at the outlet of the electric filters.

These furnaces may be grouped in batteries of two, four, or more units; each furnace of the group has its own feeding arrangement, a dust removal system, and a suitable draft-regulating apparatus, thus being assured of independence of the adjacent furnaces.

In summary, the 20-ton Spirlet furnace of reduced size (7 meters in diameter and 3.6 meters high), the rotation of the moving hearths of which requires only a low-power motor, and in which the excellent distribution of the heat furnished by the reaction permits the minimum sojourn of blende in the furnace, treats daily from 20 to 22 metric tons of crude blende containing about 30 per cent of sulphur. This figure is double the production of the four-hearth Spirlet furnace without the central tube, and of the same dimensions as the 20-ton furnace under discussion, but otherwise provided with the identical accessory equipment for charging and discharging.

It should be pointed out that the roasted blende obtained contains a maximum of 1 per cent of sulphur remaining in combination with the zinc.

The results set forth in the foregoing compare favorably with those obtained with other types of roasting furnaces. In the company's opinion, they are in favor of the 20-ton Spirlet furnace. It is further stated that this furnace may be operated without repairs for as long as two years and more, many units being now in service in roasting plants in Europe and Africa.

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A Manganese Find

IN SURVEYING the gold fields of the lower and middle Barama River, in British Guiana, in 1937 and 1938, according to D. A. Bryn Davies, the Geological Survey of that country discovered several deposits of manganese. These are in the Tasawinni district and the Pipiani district. In the former the manganiferous zone was traced intermittently 2¾ miles along the strike and over 1 mile width. The largest deposit lies on the eastern slope of a strike ridge and is traceable by ledges and boulders, some of the latter weighing over 100 tons. The material is hard, bluish-black rock, probably mainly psilomelane, of 3.3 specific gravity. It appears to be slightly porous with striated outcrops due to weathering. The deposit dips 80 deg. northwest, striking 52 deg. Maximum width appears to be about 500 ft. The length indicated by outcrop and float is about half a mile. Analysis of a bulk sample taken by blasting a representative outcrop in the wider section showed 43.17 per cent Mn, 2.74 Fe, 15.98 SiO_2, and 0.077 P. A picked sample was lower in impurities. Several other deposits were found in the district, 50 ft. or less in width and low in grade.

Seventeen miles southwest in the Pipiani district, manganiferous rubble was noted on a flat-topped hill, 400 ft. above sea level, 1½ miles northeast of Ianna River mouth. The material covers a width of 500 ft. at right angles to the strike of the country rocks. A sample taken at random showed 21.20 per cent manganese. A mile and a half northeast along the same strike the rubble covers a wide area.

The Boss and His Men

An Iron Country superintendent suggests certain rules for keeping employee relationships harmonious

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PUBLIC RELATIONS for THE MINING INDUSTRY

AFTER more than thirty years of dealing with men as a boss and a superintendent I am led to offer some suggestions with the hope that they may be helpful in these days when relations are sometimes difficult between employer and employee. They are meant primarily for the "boss," by which term I mean any one who has been intrusted with the supervision of the working hours of a number of men, whether he be a "straw boss" with his dozen men or a plant superintendent with a much larger number.

Note that I do not speak of "handling men" as if men were so many inert sacks of freight to be disposed of or wild animals to be tamed. Possibly the thought behind the expression has been responsible for much of the overbearing attitude that some bosses have displayed toward their employees under them. Men should not be "handled" but dealt with—and dealt with just as considerately as any business associate would be. This change in mental attitude is most essential to the establishment of better relations at a time when friction and misunderstanding are all too frequent.

Admittedly, the difficulty of applying these suggestions successfully increases in direct proportion to the size of the organization. Nevertheless, the aim should be the same. Even in large plants, much can be accomplished.

To the average man, the company for which he works is represented by the boss or foreman with whom he comes most in contact. It is important that these men be intelligent (not necessarily "educated"), progressive, and, above all, tactful. The selection of foremen should be considered one of the most important duties of management, one to be given as careful attention as would be given the purchase of an expensive machine. Foremen are mirrors that reflect to their men the company's attitude on matters affecting them.

Perhaps first in the list of "don'ts" for a boss is this: Don't patronize a man or allow any trace of condescension to appear in your treatment of him. Litmus paper is no more sensitive to acids than is the normal man to any such feeling on the part of his boss. If he entertains it, it is soon evident in his manner—even in his voice. One foreman of our acquaintance could hardly say "good morning" without revealing his self-satisfied sense of superiority. Consequently, to avoid displaying such a state of mind, one must avoid harboring it at all.

Treat the man who wears a dirty blue shirt just as you do the one who wears a clean white one. The human nature underneath is just the same and in almost every man you will find some trait, some knowledge or some accomplishment, which, in that respect, makes him superior to yourself. Only a small man need fear that he is lowering his dignity (another much-abused thought) by letting the men under him know that he admits this.

When you give orders (or, better, instructions) about a certain job, take time to explain briefly but clearly just what it is all about. A man's interest will be greatly increased if he knows why he is doing the thing he is directed to do, if he can visualize the completed work and its purpose.

Don't lose your temper. It does not pay and you are quite sure, when angry, to say something that will be regretted later. The good feeling created by years of patient and understanding effort may be destroyed in a moment of explosive anger. Sugar is still better than vinegar for catching flies.

Don't let your treatment of your men vary with your digestion. Be yourself, but be the same day after day—when things are going well and when they are not. Don't take your ill will out on the man who happens to be under you.

Don't have favorites. Be fair, just, helpful, and sympathetic to all your men but partial to none except as such partiality is a reward for merit and accomplishment. Then it ceases to be partiality. This is a difficult attitude to attain, but worth cultivating.

If you find it necessary to discharge a man, don't call him in and say with a snarl and, perhaps, an oath: "You're fired." Explain to him why he does not fit into your organization and see if you can help him to obtain more suitable employment elsewhere. But first be certain that he does not fit in and that your reasons for letting him go are justifiable and sound. Perhaps he was simply misplaced and would be entirely satisfactory at some other job in your plant. This has happened to men in all walks of life. So be sure you are not being unfair to the man before you force him to seek new employment with only a "discharged" slip to show for his last connection.

If a man applies for work which you cannot give him, tell him so kindly and, if possible, suggest some other place where he may be able to find employment. He is offering to you all that he has to offer—his services. A curt refusal or a sign on the door "No help wanted" sends him away with a needless and easily avoidable resentment—one step nearer to being what is commonly called a "Red."

No boss can grant every request, but at least he can give every one thoughtful consideration, even when he is certain that it cannot be granted. When you must refuse, do it tactfully and make your reasons plain. If they are sound, you will find most men willing to see your point of view and appreciative of your confidence. A refusal given kindly may leave a man more friendly toward you than the granting of a request conceded grudgingly. If, as sometimes happens, you are constrained to make a concession contrary to your desires and judgment, do it gracefully. Further, if you are convinced that some such yielding of position is imminent, do it before you are forced to, while you are better able to mitigate the harshness of its application. In this connection, try to anticipate improvements in working conditions before they are requested or demanded. If reasonable, they should be apparent to you first. An improvement initiated by you causes more appreciation than one for which the men have had to ask.

Don't be niggardly with words of encouragement and praise when they are deserved. Nothing does more to

build up a man's morale than to know that his efforts are appreciated. On the other hand, nothing does more to undermine and destroy his self-respect and his interest than to be unfairly censured.

If you find it necessary to criticize a man, wait until you are no longer "mad," and do it privately. We have seen this almost axiomatic rule of human psychology disregarded by men in very high positions.

Before you reprimand a man you should go over in your mind how you can make the reproof as tactful and "stingless" as possible, just as statesmen prepare diplomatic notes. After all, you are not trying to relieve yourself of a grouch but to make a better man of your employee. The old method of beginning such an interview with a series of "blankety blanks" is outmoded and pernicious. A well-selected organization should require little bossing and less reprimanding. The best boss is the one who gets the work done on schedule with the least bossing.

Encourage your men to come to you with complaints and suggestions. You will find, frequently, that the man who is actually doing the work has thought of something worth adopting that has not occurred to you.

Don't use the first-person-singular pronoun too commonly. "We" is more inclusive than "I," and usually more accurate.

Do your best to have your men understand that, at least as far as is within *your* power, their job is secure, that the existing pleasant relations are not going to be disturbed by you. No fear is more haunting, more destructive to "pep," morale, and ambition, than that of being out of a job with no job in sight.

Don't feel above saying "Thank you" for small services rendered by a man working for or with you, even though that service is part of his regular work.

On one occasion I happened to be in a group of men who rode for a short time in the cab of a railroad locomotive over a section of the company's track. As we got down from the cab at the end of our trip, the only member of the group (composed of foremen and men of higher positions) who said "Thank you" to the locomotive engineer was the chairman of the board, the company's highest official. I am inclined to think that it was more than mere coincidence that a man who displayed such thoughtfulness had risen to this position though still, relatively, a young man—younger than some of the others in our group. This little act exemplifies the fact that a man goes up, not on or over his fellows, but with their help. As an electric motor can do nothing until connected to a power line, so a boss can accomplish little until he has made an effective contact with his men.

Know your men by name, including their nicknames if possible, even though it requires some work and trouble to do so. A man's name is what distinguishes him from his fellows, and it is natural for him to appreciate being so distinguished by you.

As you go through your plant, mill, or job take time to bid each man whom you meet a cheerful "Good-day" and contact as many of them as you can. A brief word is time well spent. Eventually you will come to know something of the plans, ambitions, and troubles of the individual men and be able to be of service to them. Personal antagonisms are dissipated as men become better acquainted. In other words, feel and display a friendly interest in the men under you, not a paternalistic one.

When one of your men is ill or injured, try to visit him in his home. Once we had among our employees a man who was reputed to be a "very red" communist. Perhaps he was. But, on visiting him when he was ill at home, we received a most hospitable reception.

One day we picked up on the road a man whom one of our foremen had given a short layoff for losing time from work because of drunkenness. After some desultory conversation John said: "Please, Mr. Super., don't lay me off for good. You know everybody got something. You got something yourself!" We could not deny the allegation—and he came back to work.

That Matter of Loyalty

As to the loyalty of men for the company which issues their pay checks, we believe this largely resolves itself into a sense of loyalty to the bosses with whom they work. Loyalty is given for loyalty received—and for little else. If we expect such a spirit from our men, we must first evidence it to them. Loyalty and cooperation cannot be forced—they must be won.

Some managers make a hobby of one thing, some of another, depending on their training. It may be costs, equipment, efficiency, or what not; but none can afford to neglect or minimize his company's greatest asset and its greatest responsibility: its men.

Don't be afraid to say "I don't know," but do not be obliged to say it too often. The boss should make it his business to know his job a little better than any one else.

Avoid ostentation, on the job and at home. Oftentimes, too great a disparity between accoutrements or living conditions of bosses and men leads to dissatisfaction and discontent.

Support your foremen. If you find one unworthy of such support, change him.

Don't employ spies to invade meetings of any of your employees—union or non-union. The information you obtain will probably be distorted, unreliable, and misleading. This is a case where "a little knowledge is a dangerous thing."

In a dispute between two of your employees or between a man and a foreman, be sure to get both sides before making a decision. Usually there *are* two sides, and you must learn to look at every controversial matter from the man's point of view as well as your own. To the extent to which you learn to do this you will avoid those errors in judgment which often result in the assumption of an untenable position. Learn to decide matters quickly, but don't go off "half-cocked."

A superintendent was once asked by a friend what he would do if, going through his plant, he heard one of his men say to another: "There comes that ————." He replied: "I'd first sit down and think it over to decide if, perhaps, he might be right." Possibly, from that man's point of view, the superintendent had done something that justified such an unfavorable opinion. To realize what a difference the point of view makes, go to a moving picture show and sit far over on the side.

Don't bluff. If, for instance, you feel that you *must* threaten some sort of punishment to a man who habitually breaks a safety rule, make good on your threat if required. Otherwise it is better not to have made it.

Don't attempt to dictate the politics of your men, no matter how sure you may be that what you urge is for their own good. They will resent such interference with what they rightfully regard as their own prerogative—just as you would. If one of your men asks for your opinion, give it to him together with your reasons for holding it; but do not carry on an argument to the point of animosity.

Your organization is a chain whose strength can be increased only by patiently welding strength into the individual links, one by one.

To both employer and employee, this earnest admonition: As alternate waves of prosperity and depression give first one and then the other a temporary bargaining advantage, neither should let himself get into the frame of mind which says, "Now we have them where we want them." Such an attitude can lead only to trouble, for of such materials are strife and discord fabricated.

Perhaps the whole subject may be summed up by calling it an every-day application of the Golden Rule. Our experience has been that few men are unresponsive to such treatment.

One last don't. Don't say all this is only impractical idealism. We believe it is sound common sense and that along some such road lies the hope of industrial peace.

Mahogany Soap As a Flotation Reagent

Unlike oleic acid, it does not cause violent frothing in presence of slimes and is otherwise satisfactory

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PREVIOUS RESEARCH on the xanthate-soap flotation process[1] indicated the desirability of a reagent that has the collective properties of oleic acid without its disadvantage—violent frothing in the presence of slimes. During search for a reagent with these properties, mahogany soap[2], a byproduct of petroleum refining, was tested in the process with a weathered amygdaloidal native copper tailings or "sands"[3] and an unoxidized porphyry copper sulphide ore. These results were then compared with those from oleic acid under like conditions.

An important advantage in the xanthate-soap flotation process is that valuable metallic minerals quite often are segregated with readily floatable gangue, such as lime and iron-bearing minerals—the latter having been instrumental in the deposition of the former. Selective flotation, at a relatively coarse size, of these non-metallic gangue minerals from the substantially barren gangue decreases grinding because then only a part of the ore needs reduction sufficiently fine to free the desirable metallic minerals from the gangue. Because the flotation of gangue carriers of valuable metallic minerals is desirable, typical examples of these carriers (calcite, hematite, and epidote) were floated with mahogany soap. The study of these minerals, in a nearly pure state, revealed that mahogany soap floated them but that larger quantities of this reagent were required for a certain recovery than when the same minerals were floated with oleic acid. The study also showed that mahogany soap has little frothing power, a very desirable property in a non-metallic collector, and that in this respect it is different from oleic acid, which is not only a collector but also a powerful frother. This mahogany soap contains about 20 per cent of hydrocarbons of high molecular weight.[2] As the effect of these hydrocarbons is not known, an accurate comparison between the active portions of mahogany soap (sulphonic soaps) and oleic acid cannot be made at this time. However, these experiments did definitely establish that mahogany soap is a collector for the minerals mentioned in the foregoing; and it was then tested with two types of copper-bearing material.

Since the amygdaloidal native copper sands[4] were obtained from an elevation that had been above water and exposed to weathering for at least 30 years, much of the copper in it was deeply oxidized[1], whereas the porphyry copper sulphide (chalcocite) ore[4] was little oxidized when it was taken from the mine. Further, negligible oxidation of the copper sulphide occurred during the interval between mining and flotation, because the ore consisted largely of 4-in. to 6-in. lumps. These lumps were stored in tight cans and were not crushed until a few hours before flotation. After crushing to 10 mesh, 1,500 grams of the ore were wet-ground[5] in a ball mill and floated in a 1,000-gram mechanical flotation machine with potassium ethyl xanthate, pine oil, and very small quantities of either oleic acid or mahogany soap and fuel oil—conditioning and flotation periods each being five minutes. When all sizes of the ore were scavenger-floated, the tailing from xanthate flotation was treated with relatively large quantities of either oleic acid or mahogany soap and fuel oil in the same machine and, without conditioning, flotation was continued for ten minutes. With this procedure, the solids were 25 to 28 per cent of the weight of the pulp. When only the coarse portion of the xanthate tailing was scavenger-floated, the tailing was wet-screened and the +200-mesh size was then floated with potassium ethyl xanthate[6], pine oil, relatively large quantities of either oleic acid or mahogany soap, and fuel oil in a 500-gram mechanical flotation machine, without conditioning, for ten minutes. With this treatment, the solids were from 32 to 35 per cent of the weight of the pulp. When the copper sulphide ore was floated, 2.5 lb. of lime were added to the ball mill, so that the pH of the flotation pulp ranged from 10.8 to 10.9.

The results of these flotation tests with oleic acid and with mahogany soap are compared in Table I. Recoveries with the two reagents were nearly equal, but mahogany soap gave a higher grade of concentrate and less voluminous froth than oleic acid—mahogany soap flotation producing a good grade of concentrate and froth quality even when the slimes were not removed from the pulp. Under this condition, the froth from mahogany soap was brittle, and broke down as soon as it was removed from the machine; whereas the froth from oleic acid was extremely tough and remained intact for several hours. The toughness of the oleic acid froth was due to the flotation of large quantities of slimes. As an example, the concentrate from this reagent in Test 7, Table I, contained 82 per cent of —200-mesh material, whereas the mahogany soap concentrate from Test 8, Table I, contained 30 per cent of the —200 mesh size, this last reagent apparently being unaffected by slimes, since the feed to this test contained 29 per cent of —200 mesh material.

Previous work had shown that xanthate-soap flotation recovers 1½ lb. more of copper from native copper sands than xanthate flotation alone[1]. To make the same comparison with the copper sulphide ore, it was treated as in Test 8, Table I, except that, in scavenger flotation, 0.10 lb. of potassium ethyl xanthate and no fuel oil were used instead of 0.10 lb. mahogany soap and 0.30 lb. fuel oil. Comparison of the data from this work under Test 9, Table I, with those of Test 8, Table I, shows that scavenger flotation with mahogany soap instead of with xanthate increased total recovery 8 per cent (from 80 to 88 per cent) and scavenger flotation recovery 29 per cent (from 20 to 49 per cent).

A three-batch locked test was made with the sulphide ore to determine whether the mahogany-soap concentrate could be returned to the parent flotation system for regrinding and reflotation. The treatment of each batch was the same as that under Test 8, Table I, except that the mahogany soap (scavenger) concentrate from a batch was added to the next one. The results of this work (Test 1, Table II) show that a circulating load of middling, mahogany-soap concentrate

Table I—Comparison of Flotation With Oleic Acid and With Mahogany Soap

After xanthate flotation (with xanthate, pine oil, and very small quantities of fuel oil and oleic acid or mahogany soap), the tailing was scavenger-floated with relatively large quantities of fuel oil and oleic acid or mahogany soap

Test No.	Material	Grind. % −200	Xanthate Flotation: % Wt. Recov.	Xanthate Flotation: Grade Conc.	Xanthate Flotation: Cu[1] Recov.	Scavenger Flotation: Reagent	Scavenger Flotation: Head	Scavenger Flotation: % Wt. Recov.	Scavenger Flotation: Grade Conc.	Scavenger Flotation: Grade Tail.	Scavenger Flotation: Cu[2] Recov.	Scavenger Flotation: Cu[1] Recov.	Total Cu[1] Recov.
						(Only + 200-mesh ore scavenger-floated)							
1	Native[3]	31.6	0.2	41.70	28.4	Oleic	0.260	7.1	2.37	0.098	65.1	45.8	74.2
2	Native[3]	33.0	0.2	46.32	26.2	Mah.S.	0.268	1.5	10.65	0.108	60.3	44.5	70.7
3	Sulphide	36.4	3.6	12.61	83.3	Oleic	0.117	1.4	2.14	0.074	38.0	5.2	88.5
4	Sulphide	37.0	3.5	14.69	83.6	Mah.S.	0.133	0.7	4.24	0.088	34.2	4.7	88.3
						(All sizes of ore scavenger-floated)							
5	Native	38.6	0.7	24.70	52.4	Oleic	0.183	5.3	0.54	0.163	15.5	7.4	59.8
6	Native	37.7	0.5	29.20	51.5	Mah.S.	0.173	0.9	6.68	0.114	34.5	19.1	70.6
7	Sulphide	30.1	4.3	11.97	80.3	Oleic	0.133	10.8	0.58	0.078	47.7	9.4	89.7
8	Sulphide	29.3	3.1	15.85	76.0	Mah.S.	0.158	3.2	2.44	0.083	49.4	11.9	87.9
9	Sulphide	30.2	2.5	18.24	74.7	Xanth.	0.158	0.6	5.14	0.128	19.6	4.9	79.6

[1] Based on total copper content of the ore. [2] Based on copper to scavenger flotation. [3] Ground pulp wet-screened on 200 mesh before any flotation was applied and then only the oversize was xanthate and scavenger-floated.

Table Ia—Reagent Quantities for Tests in Table I

Test No.	Xanthate Flotation: Xanthate	Xanthate Flotation: Oleic Acid	Xanthate Flotation: Mah. Soap	Xanthate Flotation: Fuel Oil	Xanthate Flotation: Pine Oil	Scavenger Flotation: Xanthate	Scavenger Flotation: Oleic Acid	Scavenger Flotation: Mah. Soap	Scavenger Flotation: Fuel Oil	Scavenger Flotation: Pine Oil
1	0.25	0.01	....	0.03	0.10	0.25	0.20	....	0.65	0.10
2	0.25	....	0.01	....	0.10	0.25	....	0.20	0.15	0.10
3	0.10	0.05	....	....	0.10	0.10	0.25	....	0.65	0.10
4	0.10	....	0.05	....	0.10	0.10	....	0.60	0.50	0.10
5	0.25	0.01	....	0.03	0.10	....	0.04	....	0.12	....
6	0.25	....	0.01	0.03	0.10	....	....	0.04	0.12	....
7	0.10	0.01	....	0.01	0.10	....	0.10	....	0.30	....
8	0.10	....	0.01	0.01	0.10	....	....	0.10	0.30	....
9	0.10	....	....	....	0.10	0.10	....	....	....	....

was built up in the grinding and flotation system. The fact is indicated by the increase in grade and total copper content of the soap concentrate.[7] This condition, which was due primarily to the relative hardnesses of value-bearing and barren gangue minerals, was brought about by insufficient grinding[8] of the soap concentrate, so that its valuable minerals were not freed and could not pass into the xanthate concentrate. The addition of the mahogany-soap concentrate (both mineral and solution) to the next batch caused an increase of frothing in xanthate flotation which was corrected by reducing the pine oil to 0.05 lb. and increasing the fuel oil to 0.04 lb. per ton.

The information that was gained from the first locked test mentioned in the foregoing was applied to a second one. The conditions of the second locked test were the same as of the first except that no lime was added to grinding or flotation. Also, the mahogany-soap concentrate was ground separately in the ball mill until most of it was of —200-mesh size, the new ore was then added to the ground concentrate, and grinding was done in the same ball mill and in the usual way. The results from this locked test, given under Test 2, Table II, show that the change in grinding procedure largely overcame the building up of middling material.

The tailings from Test 1, Table II, were better than those of Test 2, Table II, apparently because lime was present in the first test. Therefore, Test 3 of Table II was made similarly to Test 2 except that 2.50 lb. of lime were added to the ball mill. To learn whether there was increase in the copper content of the tailing from return of the ground mahogany-soap (scavenger) concentrate, the tailing was separated into plus and minus 200-mesh sizes, and copper was determined in both sizes of tailing from each batch. (Increase in copper content, if any, should occur in the —200-mesh tailing because most of the concentrate was ground finer than 200-mesh size). The tailing-product assays from the different batches follow in the order in which the tailing was obtained from the locked test. The +200-mesh size of tailing contained 0.064, 0.079, 0.084, and 0.063 per cent copper; the —200-mesh tailing contained 0.047, 0.040, 0.043, and 0.041 per cent copper. These assays show that there was no marked increase of copper in the —200-mesh part of the tailing or in the whole tailing—the copper contents of the tailing products from the last batch being as small as those from the first. The data from this test also support the previous findings that the presence of lime reduced the copper content of the tailing to a considerable extent.

Locked tests were not made with the weathered amygdaloidal native copper sands, because good results with this material had been obtained with previous locked and continuous tests[1]. When they are considered as a whole, the tests mentioned showed that xanthate-mahogany-soap flotation of the weathered amygdaloidal native copper sands and copper sulphide ore produced fair grades of xanthate and scavenger concentrates, good tailing, and excellent froth quality.

The foregoing data indicate that the use of mahogany soap in combination with ethyl xanthate is technically feasible even when slimes are not removed from the pulp. Concerning the economic feasibility of the process for the copper sulphide ore, 0.9 to 1.3 more pounds of copper per ton of ore[9] were recovered by the expenditure of about 1¼ cent[10] for mahogany soap and fuel oil.

With weathered amygdaloidal native copper sands, previous tests in a 350-ton commercial unit showed that xanthate-oleic flotation saves 1.5 more pounds of copper than xanthate flotation[1]. As mahogany soap was as effective as oleic acid, it is assumed that 1.5 more pounds of copper can be recovered from a ton of the sands at a cost which is about equal to that for the sulphide ore. Further, with the use of mahogany soap, classification of the xanthate tailing into slime and coarse material and reflotation of the latter, such as was done in the xanthate-oleic acid process, would not be necessary, because the new reagent functions well when slimes are present in the pulp. Thus the tailing from xanthate flotation would need only to be refloated with mahogany soap and fuel oil.

Of economic importance, also, is a comparison between the amount of grinding which was done on the copper sulphide ore and that which was required for comminution to finer sizes. In preliminary tests with this ore, it was ground for eight minutes, and 40 per cent of it was reduced to —200-mesh size. As the tailings from these tests were satisfactory, the time of grinding was reduced to six minutes in Tests 3 and 4 of Table I, and finally to four minutes in Tests 7 and 8 of Table I and Tests 1, 2, and 3 of Table II. Thus in the last tests only one-half as much grinding was required to reduce 30 per cent of the ore to —200-mesh size as was necessary to reduce 40 per cent of it to the same size in the preliminary tests.

The process was also tested on another porphyry copper sulphide (chal-

copyrite) ore with sodium Aerofloat as the sulphide collector; cresylic acid as the frother; oleic acid, mahogany soap, sodium lauryl sulphate or sodium octadecyl sulphate as the metallic and non-metallic collector; and fuel oil as a collector and froth regulator. As in the tests on the preceding copper sulphide ore (Tables I and II), the presence of lime was beneficial; it probably served as a conditioner and activator. In every test, flotation with these combinations of reagent showed improvements over usual flotation with a sulphide collector which were similar to those of the tests in Tables I and II.

Microscopic examination was made of the products from the tests described to determine how the combinations of reagents improved flotation. This examination showed that the scavenger concentrates contained (a) relatively floatable non-metallic mineral particles, many of which had entirely occluded desirable metallic minerals; (b) middling with readily floatable non-metallic gangue; (c) middling with relatively unfloatable non-metallic gangue; and (d) coarse oxidized and/or unoxidized metallic minerals. The examination showed that the xanthate concentrates also had coarse oxidized and/or unoxidized metallic minerals; in fact, the coarseness of the floated particles was outstanding in both the xanthate and the scavenger concentrates, +35-mesh native copper, pyrite, chalcopyrite, chalcocite, and middling materials being floated in both concentrates.

The combinations of reagents probably produced these results in the following way: Relatively floatable non-metallic minerals were selectively floated from other non-metallic gangue as in usual soap flotation—the occluded valuable metallic minerals having no part in this selective flotation. Concerning middling with relatively floatable gangue, the oxidized or unoxidized metallic mineral portion was filmed with the sulphide collector or products thereof, and thereafter the whole particle was first coated with the metallic and non-metallic collector or products thereof and then with fuel oil. In this way, middling with extremely small portions of valuable metallic minerals and relatively coarse middling particles, which were unfloatable with a sulphide collector alone, were floatable with the combinations of reagents, since the entire surface, rather than only a part of it, was water-repellant.

With middling which had relatively unfloatable non-metallic gangue, the oxidized or unoxidized metallic mineral part was covered with the sulphide and also with the metallic and non-metallic collectors or reaction products thereof. This part then served as a nucleus from which there proceeded the filming of the entire particle with the reaction product of the metallic and non-metallic collector and an activator, for the tailing had much similar gangue material without exposed metallic minerals. As before, middling unrecoverable by usual sulphide flotation was floated with the combinations of reagents. Oxidized and unoxidized metallic minerals were first filmed with the sulphide collector or products thereof, then with the metallic and non-metallic collector or products thereof, and finally with the hydrocarbon. Thus the selectivity of the sulphide and the flotative power of the other two collectors were obtained.

As an example, the +35-mesh size of the mahogany soap (scavenger) concentrates from the native copper sands had both oxidized and unoxidized native copper. This size had a grade of 85 to 90 per cent and carried about 10 per cent of the copper in the whole concentrate. Flotation of high-grade xanthate concentrate and the cleaning of reground xanthate concentrates were done by limiting the quantity of the metallic and non-metallic collector—flotation of non-metalic minerals beginning after the metallic minerals had been saturated with this reagent.

A study having been made of mahogany soap in the flotation of copper ores, it is being studied in the same way with lead and other metallic and non-metallic ores. (As an example, the reagent has shown marked collective properties toward barite.) To realize its possibilities more completely, a theoretical investigation of the reagent is also being made by observing the flotative properties of its active portions (sulphonic acids and their derivatives as an example) with ores and very pure minerals.

Grateful acknowledgment is made of the aid which the authors have received in this work. They are especially indebted to G. C. Dillman, president; to N. H. Manderfield, professor of metallurgy; and to C. T. Eddy, director of metallurgical research—all of the Michigan College of Mining and Technology.[11]

REFERENCE NOTES

[1] W. E. Keck, Paul Jasberg and Arthur Schnaufer: "Xanthate-Soap Flotation," *E.&M.J.*, Vol. 139, No. 3, 33, 1938.

[2] The authors are indebted to Arthur J. Franks, technical advisor, Sherwood Petroleum Company, Warren, Pa., for a sample of and data on Reagent 407, the mahogany soap that was used in these tests. Although it is called a soap, this material is not a soap from a chemical standpoint—among its active portions are sodium salts of sulphonic acid.

[3] Throughout this article the tailing will be referred to by the local designation "sands." This procedure will prevent confusion of these materials with the tailings from the present experimentation.

[4] The native copper sands and the copper sulphide ore were furnished respectively by the Copper Range Mining Company, Painesdale, Mich., and the Miami Copper Company, Miami, Ariz.

[5] Laboratory tap water (lime and chloride, 39 and 18 p.p.m.) was used throughout these tests after experimentation had shown that this concentration of calcium and other chlorides had no adverse effect on recovery but slightly reduced the grade of concentrate.

[6] Another addition of these reagents was made because the original portion had been largely lost in the xanthate concentrate and washed away during screening.

[7] Compare this mahogany-soap concentrate with that of Test 8, Table I, from the standpoints of grade and distribution of copper.

[8] The flotation feed became somewhat coarser as the mahogany soap concentrate was reground with a constant quantity of new ore and time of grinding—the feed to the third batch (Test 1, Table II) containing 71 per cent +200, 30 per cent +48, and 0.2 per cent +14 mesh.

[9] Based on the tailing assays of Test 8 (Table I), the locked tests (Table II), and Test 9 (Table I). The xanthate concentrate from both of the processes must be reground and cleaned; therefore the additional loss of copper in the tailing due to this operation was not considered—it being assumed that these losses would be nearly equal in both cases. The xanthate concentrate was not reground and cleaned, because the quantity of it from one batch was too small for this treatment. However, the xanthate concentrates from the three batches of Test I, Table II, were combined and then reground and given a single cleaner flotation. By this treatment, 82 per cent of the copper content of the xanthate concentrate was recovered in a cleaner concentrate with a grade of 30.82 per cent copper, and 18 per cent of the copper remained in a cleaner tailing with a grade of 3.15 per cent copper. These data indicate that the use of mahogany soap and fuel oil did not interfere with cleaning of the xanthate concentrate.

[10] This reagent cost was computed by assuming a delivered price of 1.0c. per pound for fuel oil and 8.25c. per pound for mahogany soap. Reagent 407, the grade of mahogany soap used in the experiments detailed, is quoted f.o.b. Warren, Pa., as follows: lots of 10 55-gal. drums or more, 6.25c. per pound; carloads of drums, 6.0c. per pound; and tank cars, about 0.5c. less than carload prices—these quotations being approximate and subject to change with market conditions.

[11] Patents on the reagents and process described in this article have been applied for and all rights to them are reserved by W. E. Keck, assignor to the Michigan College of Mining and Technology.

Table II—Locked Tests on Copper Sulphide Ore

Xanthate flotation with 2.5 lb. lime, 0.11 lb. ethyl xanthate, 0.05 lb. pine oil and 0.04 lb. fuel oil. Tailing from xanthate flotation scavenger-floated with 0.11 lb. mahogany soap and 0.30 lb. fuel oil.

		Xanthate Flotation			Scavenger Flotation[1]					Total	Grade of Tailing				
Test No.	Grind % −200	% Wt. Recov.	Grade Conc.	Cu[2] Recov.	Head	% Wt. Recov.	Grade Conc.	Cu[3] Recov.	Cu[4] Recov.	Cu[2] Recov.	1st Batch	2d Batch	3d Batch	4th Batch	Average
1	28.3	4.3	11.93	79.5	0.266	3.6	5.19	30.3	72.6	90.0	0.061	0.063	0.075	.....	0.067
2	30.8	3.1	16.58	83.8	0.137	1.8	2.93	8.7	38.8	86.7	0.101	0.066	0.086	.....	0.084
3	29.9	3.8	13.76	87.5	0.124	3.2	2.00	10.8	56.1	90.2	0.059	0.067	0.072	0.056	0.064

[1] Scavenger flotation of last batch. Copper recoveries are based on [2] copper in all batches, [3] copper in last batch, and [4] copper to scavenger flotation of last batch

An aerial view of the Oronogo Circle open pit and surrounding territory. The Eagle-Picher company's American mill is in the upper right. The hole shown in the center is the area mined out by the Connecticut Zinc Company

An Open-Pit Zinc-Lead Mine
In the Tri-State District

Oronogo Mutual enterprise made possible by a combination of several circumstances

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"ORE OR NO GO" was the slogan of the early prospector around Minersville, Mo., as he optimistically started his "lead gouge." The prospector's optimism was justified, for ore was struck at the "grass roots," and soon Minersville was a thriving mining camp like numerous others in Southwest Missouri shortly after the close of the Civil War. The miner's slogan was later contacted and the town named Oronogo when a post office was established. After a hectic career, followed by many years as a ghost camp, Oronogo is again fulfilling its destiny as a history-making camp.

In 1867, the 40-acre tract containing the Circle deposit was acquired by the old Granby Mining & Smelting Company, holdings of which were taken over in 1916 by the American Zinc, Lead & Smelting Company, the present owners. In the succeeding years the numerous small operations were consolidated into one large operation, which, after passing through several hands, was acquired by the Connecticut Zinc Company in 1913. Under the supervision of Arthur Raymond this company closed down all shaft mining in 1917 and started strip-mining operations, using a steam shovel, locomotives, and flat cars. The ore was loaded on the 230-ft. level with scrapers. Prior to stripping, pillars in the old workings were pulled and two acres in the western portion of the Circle was caved. Subsequent attempts to mine the ore from the upper horizons were unsuccessful because so much shale had become intermixed with the broken ore that the grade was lowered to an unprofitable level. Stripping was partly completed from the remainder of the Circle, but, with the drop in prices following the close of the World War, operations became unprofitable, and the property was closed down after having incurred an operating loss of $1,800,000.

Guy H. Waring, who had been familiar with previous operations, began stripping operations in February, 1936, as manager for the Oronogo Mutual Mining Company. The major

part of the stripping is now complete, and 650 tons of sulphide ores are being treated daily by the American mill of the Eagle-Picher Mining & Smelting Company at Oronogo. Mixed oxidized and sulphide ores which must be moved are being stockpiled for future concentration when prices are more favorable.

Geology—C. R. Van Hise and H. F. Bain[1] explain the origin of the Circle deposit as the result of a fault along which a narrow block has been dropped approximately 140 ft. The position and course of the fault are shown in Fig. 1. This concept is accepted with reservations by geologists who have visited it in more recent years after more mining had clarified the picture. It is now thought that a single northwest fault of small displacement, with an accompanying sheeted zone and cross fractures, produced the channel through which the ascending ore-bearing solutions entered. Partial solution of the limestones caused the overlying Chester and Cherokee formations to slump. It is interesting to note that the Reeds Springs horizon (R bed of Fowler and Leyden[2]), which has been mined on the 230-ft. level, shows virtually no vertical displacement.

Fig. 2 shows an idealized section across the Circle from east to west. As indicated, there is a rim of mixed oxidized and sulphide ores between the Chester strata and the main sulphide orebody in the lower levels. Some mineralization occurs in the Chester limestone, but it is somewhat spotty.

Ore Reserves — Waring estimates that more than $15,000,000 worth of ore has been recovered from fourteen acres, which comprise the Circle proper, but that only two acres have been thoroughly worked. He estimates that in the remaining twelve acres which his company plans to develop. there is a potential reserve of 1,323,500 tons of ore, not including the oxidized zone, which probably will exceed 1,000,000 tons. It is expected that the minable sulphide ores will have an average grade of 6 per cent combined zinc sulphide and lead sulphide.

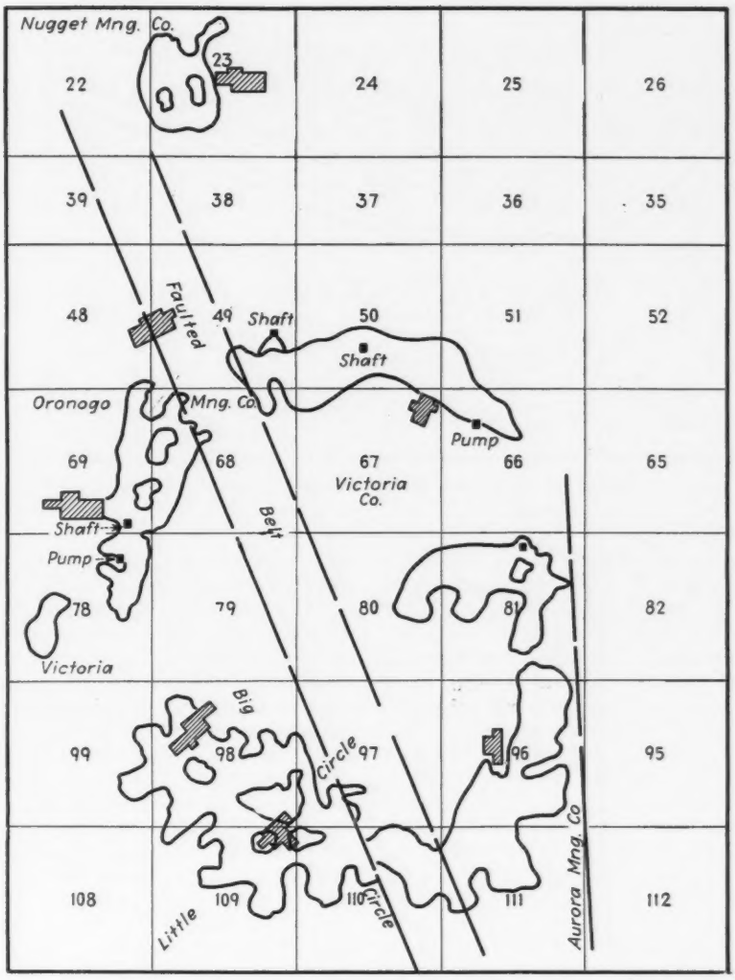


Fig. 1. . . Underground workings of the Oronogo Circle mine, Oronogo, Mo. (After S. J. McKee). The numbers represent mining lots, each representing a 200-ft. square

Stripping and Mining—Stripping operations were begun in February, 1936, by cutting the southernmost haulage road shown on the map on a minus 15 per cent grade. A ¾-cu.yd. Invincible shovel powered by a gasoline motor was first employed and later was supplemented by a ½-cu.yd. Osgood shovel. These two shovels are used for both stripping and ore-loading operations. At present the two shovels are moving about 2,500 tons of ore and waste in two 8-hour shifts. The ratio of waste to ore is approximately 2 to 1.

Waste and ore are loaded into 5-ton Ford end-dump trucks as shown in the illustration. The waste is trucked about one-quarter mile across the highway from the pit. The ore is trucked about the same distance, as the mill is just south of the waste dump. Five trucks are in use; two trucks serve the Osgood shovel and three trucks serve the Invincible.

Because of the broken character of the overburden, only a minimum of drilling and blasting is required. One drill crew keeps the lime and shale of the surface and upper bench broken, while a second crew handles the rest of the waste between the upper

Two power shovels stripping on bench No. 1 early in April, 1939. In the background are the remains of the tailing pile and old mill piers

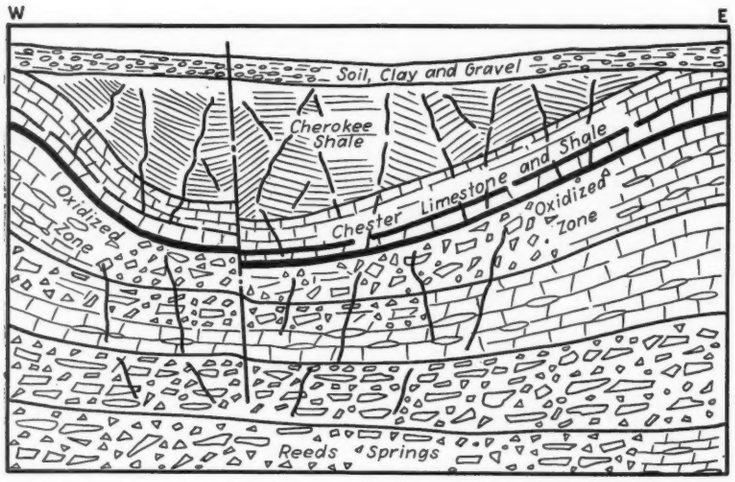


Fig. 2. . . An idealized section through the Oronogo Circle deposit from east to west

and lower benches. Three crews are required on ore. At present all the ore is being obtained from pillars and the roof or back which had been left to protect the former underground workings. Each crew consists of a machine man (miner) and helper or "dummy." Denver D-98 drills mounted on tripods and using 1¼-in round steel are used for all drilling. The starter gage is 2½ in. with ⅛-in. drop in gage to 1½ in. The holes are bottomed with 16- or 18-ft. steels. A stope hole or bottom hole inclined slightly below horizontal is drilled in the toe of the bench, and a splitter hole, inclined upward, is drilled about midway between the toe and top of the bench. The benches are normally about 20 ft. high.

Only five boxes (250 lb.) of 1¼x8 Alton Mine-Gel No. 5 are required per shift. Blasting is done by cap and fuse at the end of the day shift. All boulders are blockholed with jackhammers and reduced to approximately 11 in., as this is the size of the grizzly openings ahead of the mill hopper.

Compressed air for drilling is furnished from the central compressor plant of the company located about three-quarters of a mile south of the mine. The compressors are all powered by Caterpillar diesel engines. One compressor man and one blacksmith for sharpening the drill steel are located at this plant.

A total of 31 men are required for the entire stripping and mining operations on the two shifts. They are divided as follows: Machine men, 5; Machine helpers, 5; Truck repairmen, 1; Compressor man, 1; Blacksmith, 1; Superintendent, 1; Assistant superintendent, 1; Watchmen, 2; Truck drivers, 10; Shovel operators, 2; Shovel oilers, 2.

The men work six 8-hour shifts per week and are paid time and one-half for the extra four hours. Only four days were lost during the past winter due to inclement weather.

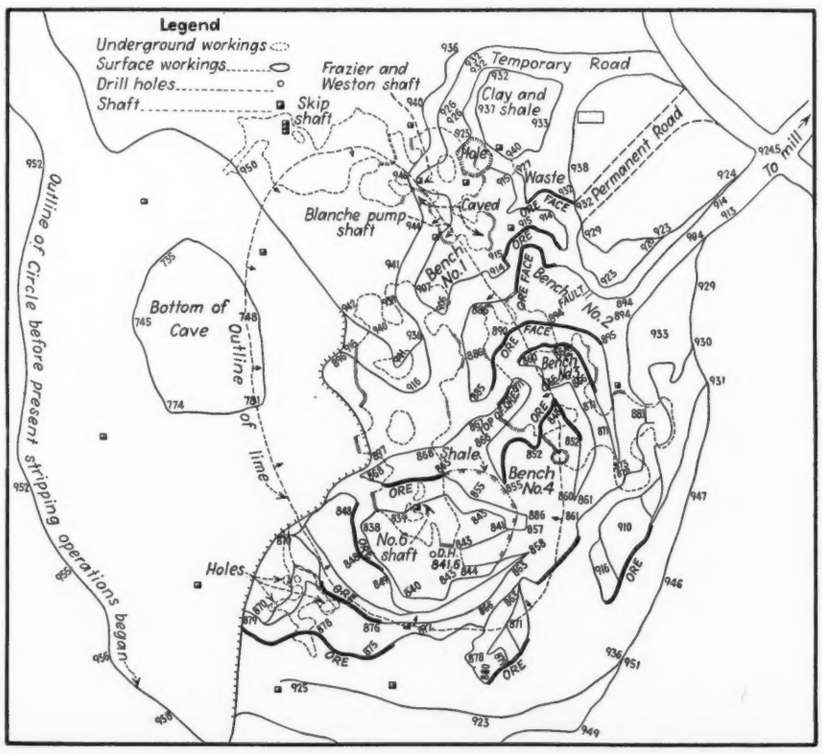
The American mill of the Eagle-Picher Mining & Smelting Company at Oronogo was built through the joint efforts of the Eagle-Picher company, the Oronogo Mutual Mining Company, and the American Zinc, Lead & Smelting Company, present owners of the Circle property. The Oronogo Mutual has a working agreement with Eagle-Picher to furnish the last named company with a specified amount of ore each week. It might be well to add at this point that it was only because of the unwatering operations of the Eagle-Picher company in the Oronogo and Webb City area that mining at the Circle and other mines in the area was possible.

Costs—Mr. Waring reports that he is able to strip the overburden and mine ore for a cost of less than 15c. per ton of waste and ore. For this reason he is able to operate the open-pit mine even at the present low prices for concentrates. The grade of ore being concentrated at present averages about 6 per cent combined zinc and lead sulphides, which checks the estimates originally made.

In conclusion, we may say that open-pit mining at the Oronogo Circle mine has been made possible by a combination of circumstances. The geology of the deposit made it amenable to this method of mining, but it was not until the Eagle-Picher Mining & Smelting Company had lowered the water in the area that the Oronogo Mutual company was in a position to undertake the hazardous stripping work. The location of the custom mill operated by the Eagle-Picher company adjacent to the pit left the Oronogo Mutual Company free to put all its resources into the development of the mine. Careful planning and efficient operation have made possible the low mining costs which permit mining even under the present unfavorable concentrate prices.

We are especially indebted to Guy H. Waring, manager of the Oronogo Mutual Mining Company, for his cooperation in furnishing the informa-

Fig. 3. . . Map of the Oronogo Circle pit, as operated today by the Oronogo Mutual Mining Company. The benches are shown



tion and maps that make this article possible, and to Evan Just, secretary of the Tri-State Zinc & Lead Ore Producers Association, for his helpful criticism.

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Infra-red Rays for Miners

AT THE Sälzer-Amalie colliery of the Krupp-Bergwerke, Essen, Germany, the miners are exposed to rays from infra-red and ultra-violet lamps in passing through corridors 40 ft. long between the room when they remove their ordinary clothes and the one where they put on their mine wear, this according to *Schuth. Kohle u. Erz,* Nov. 1, 1938, abstracted by *Colliery Engineering,* March, 1939. This treatment is given twice a week starting with an exposure of 1 minute and gradually increasing to 5 or 6 minutes. The object is to repair the effects of the miners' withdrawal from sunshine, amounting to at least 100 days per annum. The undressed men have to walk sideways between rail-barriers arranged so that slow movement is automatically insured.

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Further Tests On Alunite

FURTHER experimental work has recently been done on the alunite ores of the Marysvale region of Utah by the Electrometallurgical Section of the United States Bureau of Mines. A method involving the sintering of alunite with boric acid and subsequent treatment of the sinter to produce alumina and potassium sulphate (with some excess sulphuric acid) is described in Report of Investigations 3438 by J. Koster, R. G. Knickerbocker, A. F. Fox, and P. R. Perry. The report states that plant feasibility of the process can be ascertained only from tests on a larger scale. The leaching and filtering involved undoubtedly could be handled efficiently in standard chemical engineering equipment. The work on electrolytic precipitation of alumina is not complete; however, it seems that it has considerable merit and should be investigated more thoroughly.

The Jones Riffle In Cutting Down Samples

Variation in results obtained is studied in the course of reducing the bulk of 136 mine samples taken while examining a property in the Philippines

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SAMPLING A MINE remote from transportation presents many practical difficulties aside from the technique of cutting the samples to satisfy the purposes of the examination. Particularly is this true of gold properties where the almost universal erratic character of the mineralization requires generally a much closer sampling interval than for base metals as well as a larger amount of material to be taken per foot of channel cut. The result is that the examining engineer will end up his work with well over a hundred samples for even a moderate checking job; and a complete examination may easily run several times that number. If he has cut 2 or 3 pounds per foot of channel across stoping width of 5 ft., he will have more than a half a ton of samples to get back to the assay office, unless he decides to use the facilities at the mine, which for obvious reasons he may not desire to do.

In a recent examination I had 136 samples to take out for assay. Individual samples cut in the mine weighed on the average 15 lb. The ore had a highly erratic gold content, with the values both in the quartz and the sulphides, and previous sampling had shown assays from 0.05 oz. to over 10 oz.; yet gold was not visible under the microscope in any instance. The mine was still in the development stage and the only transportation was over a steep mountain trail 25 km. from the nearest road—about six hours' walking. No pack animals were available.

We determined to cut down the samples at the mine to about 1 kg. each. Samples were dried and crushed by my assistants to —¼ in. size in a Chipmunk crusher at the mine assay office, and then quartered down by them, using the usual Jones splitter. Every precaution was taken to insure an accurate split.

The original sample was split three times, reducing the weight from about 15 lb. to 2 lb. Duplicate final samples were then boxed up and sent to different assayers. The rejects from the splitter were given to the mine assayer to run. Thus three separate assays were available for comparison from samples taken off the Jones splitter, representing in theory a fair section of the original. The methods used by each assayer were investigated and appeared to be standard, and each man had an established reputation for accurate work.

In only a few cases were the three assayers in close agreement in their results on individual samples. As might be expected, the greatest variations occurred in the assays of the high-grade samples, as will be noted in Table I.

These results are not as disconcerting as they might appear at first glance. The arithmetical average of the entire 136 assays by one assayer was 0.687 oz., and by the second, 0.647 oz. This is a difference of only 0.04 oz. ($1.40). If five high-grade samples had been omitted, the comparative arithmetical averages would have been 0.431 oz. and 0.424—a difference of 0.007 oz. ($0.24)

In other words, the law of averages asserts itself in samples taken on the Jones splitter if these results offer a fair criterion. A close analysis of the assays indicates that where one assayer was below the others on a

Table I—Results of Assaying 136 Samples

Grade of Ore Oz. Per Ton	Number of Samples Run	Average of Assays in Group, Oz. Per Ton	Average of Maximum Variation in Assays, Oz. Per Ton	Per cent of Maximum Variation From Average Assay
0.01–0.10	33	0.063	0.030	47.5
0.10–0.30	40	0.210	0.065	30.9
0.30–0.50	17	0.365	0.084	23.0
0.50–1.00	22	0.677	0.199	29.5
1.00–2.00	17	1.400	0.436	32.2
Over 2.00	7	5.350	2.870	53.5
	136	0.682 [a]	0.272 [a]	

[a] Weighted.

Table II—Results of Assaying Six High-grade Samples

Sample No.	Assayer No. 1	Assayer No. 2	Assayer No. 3	Maximum Deviation Below High Assay	Minimum Deviation Between Assays
1	5.04	5.80	6.22	1.18	0.42
2	8.30	3.80	7.22	5.50	1.08
3	6.44	5.62	6.36	0.82	0.06
4	1.62	2.29	2.00	0.67	0.29
5	7.40	12.61	8.76	5.21	1.36
6	3.10	3.60	3.14	0.50	0.04
Arithmetical average	5.316	5.620	5.616	2.31	0.54

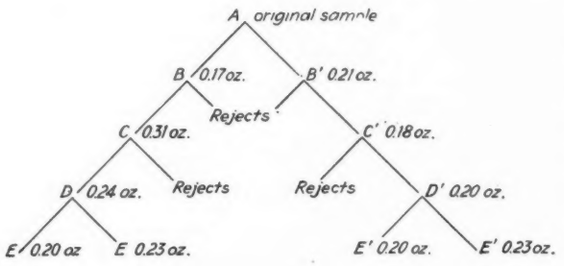
certain sample, he would quite likely be above the others in a following one, so that the average of all would not be much out of line, provided a large number of samples were run. The results from assay of six high-grade samples are of interest in this respect. They are given in Table II.

Assayer No. 1 had used the rejects from the Jones splitter; assayers 2 and 3 had received duplicate samples from the third split, as already explained. No effort had been made to crush beyond standard practice before splitting—that is, minus ¼ in. Due to the deceptive appearance of the ore and the absence of any visible free gold, it was quite impossible to tell whether the ore would assay high or not, and these samples were treated exactly the same as the others in preparation for assaying. It will be noted that in spite of the general lack of harmony in individual results, the difference in the final averages is not large.

Though the percentage variation of the assays is high on very low-grade material ($2.20), the actual variation of 0.03 oz. is well within a reasonable margin of error, always bearing in mind of course that the assayers were not working on the same finely ground-up pulp, but on split samples of about 1 kg. each. It is also true that on material of such low gold content a very slight inclusion of gold in the sample would increase the assay from say 0.01 to 0.03 oz., a negligible amount from a practical standpoint, but very large in percentage. It is also possible that less care may have been given in weighing, when visual inspection of the button disclosed that the ore was far beyond pay limits in any event.

On the average material assaying less than 0.5 gold, which comprises 66 per cent of the samples, the average weighted variation is 0.055 oz., or $1.92, on ore with a weighted average value of 0.185 oz., or $6.37. Most authorities agree that a variation of 0.02 oz. is allowable by the same assayer on low-grade ores or by different assayers working on small, finely pulverized lots. Such a comparison would be unfair in the present instance, as each assayer had a different sample to pulverize, although each in theory represented a fair split from the original. The conclusion appears justified that split samples taken on gold ores of variable content by a Jones splitter or similar device may show variations of as much as 25 or 30 per cent between assays unless the original sample is crushed down to much finer than —¼ in. before splitting.

Another example may be cited: In the examination of a gold property already in production, a general check-up of the assay map was made and 88 samples were taken from channel cuts. These samples included many that were known to be submarginal in grade, as well as some high-grade material; hence assays ran from a trace to over 14 oz. per ton. Samples averaged 15 lb. each, and were dried, crushed, and quartered at the mine, but in this instance, because transportation was not too difficult, they were split only once, and the duplicates were given to the mine assayer to run. Thus, each sample represented about 7 lb. The results from individual samples varied in some instances within rather wide limits, but the arithmetical average of 82 samples, eliminating six samples that carried over 2 oz. gold each, was 0.254 oz. by the mine, and 0.189 by an outside assayer. This is a difference of 0.065 oz. or $2.27, on ore with a mean average value of $7.75, or 29 per cent—about the same as in the first case cited. Oddly enough, if the six high-grade samples were included in the arithmetical averages, both assayers checked each other almost exactly, $14.59 and $14.75 respectively for the 88 samples.



An attempt was subsequently made to get the variations in samples from a Jones splitter when working on a fairly uniform ore. With this in mind, a 36-lb. sample of ore known to run about $7 was crushed to —¼ in. size, spread on galvanized iron, and thoroughly mixed. It was then split in half with a Jones splitter, and the two samples, one called the original and the other the duplicate, were carried through as separate samples, but both treated the same. Samples for assay weighed about 400 grams. Each was finely pulverized, well mixed, and run in duplicate with charges of one assay ton each. It will be noted that the original sample was cut four times, giving ten determinations as shown in the sketch.

The average of determinations from the ten split samples was 0.217 oz., which gives a close check on what would ordinarily be the final samples, E and E′. Yet the variation in assay between individual samples is surprisingly large, with a total maximum variation between samples B and C of 0.14 oz. On the other hand, the variation between the duplicate samples is little.

The practical conclusion from this work appears to be that though the engineer should be wary of placing too much reliance on the assay result of a few samples from a Jones splitter as being truly representative of the ore, he may have considerable confidence in the averages of a large number as being indicative of the true assay value. Particularly in obtaining samples of high-grade ore from such a device as the Jones splitter is it necessary to crush much finer than —¼ in. if any concordance in assays is to be expected. Safety lies in obtaining the largest number of samples that conditions of the examination warrant, not only for the purpose of sampling the vein adequately, but for the protection of the assayer in determining value.

Both women and men act as porters over mountain trails in the Philippines

PERSONAL ITEMS

Richard Vail has returned to the United States from a trip to Costa Rica.

V. G. Gabriel is to be addressed at 290 South Michigan Ave., Pasadena, Calif.

Frank R. Beggs has been appointed general manager of Gold Mines of Papua, Ltd., Misima Island, Papua.

C. F. Parker has been appointed safety engineer at the property of Veta Mines, in the San Juan district of Colorado.

C. J. Braden has been appointed manager of Kelsey Creek Gold Mines, Pty., Ltd., near Proserpine, North Queensland.

William Sharp is directing development in new territory in Secret Canyon, near Eureka, Nev., for the Eureka Corporation Ltd.

F. Van Waeland has been appointed manager of Yellowdine Gold Options, N.L., Southern Cross, Western Australia.

Lucien Eaton has resigned from his post as general manager of Isle Royale Copper Company. He will resume consulting practice.

Erroll Gordon May has been made a director of West Rand Consolidated Mines, to fill a vacancy caused by the death of A. G. Gill.

Oscar Hershey has been in Nevada from his San Francisco office to examine mine properties near Silver City in the Comstock district.

Enoch Perkins, of Mutual Chemical Company of America, sails from San Francisco on June 20 for Australia and New Caledonia. He expects to return early in 1940.

Bernard I. Manderfield has been appointed superintendent of the Champion mine of the Copper Range Company at Painesdale, Mich.

K. J. T. Ekblaw, agricultural engineer for the American Zinc Institute, has been elected president of the American Society of Agricultural Engineers.

Lawrence B. Wright, of Wright, Dolbear & Company, Ltd., recently completed an examination of the Enob Hill Mines, Inc., at Republic, Wash.

Albert W. Hahn, president of Metalead Products Corporation, recently returned to his office, 910 Balfour Bldg., San Francisco, following a business trip to New York City.

Paul Redeker, lately superintendent of the Copper Range Company's Baltic mine, has accepted the superintendency of the Isle Royale mine, in Houghton County, Mich.

Alfred J. Coulls, who for some years has represented the British Metal Corporation in Vancouver, B. C., has been transferred to the Montreal office of the company.

Antoine M. Gaudin has been appointed Richards professor of mineral dressing at the Massachusetts Institute of Technology. Professor Gaudin comes to the Institute from the Montana School of Mines, where he has been research professor of mineral dressing and particularly active in research on flotation, on

ANTOINE M. GAUDIN

which he is an outstanding authority. He was born in Turkey in 1900, his father then being an engineer in the service of the Turkish Government. He was educated at the Lycees at Versailles and Toulon. During the World War Professor Gaudin's father came to the United States as a member of the French War Mission. The younger Gaudin joined him in 1917 and entered Columbia, where he completed a six-year course in four years, being graduated with the degree of engineer of mines. He enlisted in the United States forces in 1918, serving until after the Armistice. In 1924 he was invited to become a lecturer in mining at Columbia, where he remained until 1926. Professor Gaudin is a member of the A.I.M.E., the Mining and Metallurgical Society of America, the Electrochemical Society, the American Chemical Society, and the Société des Ingenieurs Civils de France.

Charles H. Segerstrom, president of the Nevada-Massachusetts Company Inc., producer of tungsten concentrate, has been at the property at Mill City, Nev.

Warren Gilkison recently joined the staff of Cia. Minera Unificada del Cerro de Potosi, in Potosi, Bolivia, having resigned his post with the Itogon Mining Company, in the Philippines.

Lewis M. Robinson, lately superintendent of Suyoc Consolidated Mining Company, in the Philippines, has become general superintendent of Itogon Mining Company, succeeding Warren Gilkison.

Harry J. Wolf, mining engineer, and financial advisor of H. J. Wolf Associates, has moved his office from 285 Madison Ave. to 34 East 11th St., New York City.

R. E. Phelan, long general manager for Hudson Bay Mining & Smelting Company, has retired from active duty but will continue with the company in a consultative capacity.

George W. Hallock, president and general manager, Sixteen-to-One Extension Gold Mines, Ltd., Alleghany, Calif., has been reelected president of the California Hydraulic Mining Association.

Lucian Eaves, until recently mine superintendent at the Spanish mine of the Bradley Mining Company, has joined the staff of Getchell Mine, Inc., Golconda, Nev.

Carl G. Barth, Jr., mining engineer of Prescott, Ariz., has been appointed field engineer for Yavapai and Maricopa counties by the Arizona Department of Minerals.

George E. Lynch, consulting engineer specializing in problems of dusts and fumes, has been retained by the Climax Molybdenum Company to assist the company's engineers on such problems.

Dr. A. M. Heron will retire from the directorship of the Geological Survey of India on July 31. He joined the Survey in 1906 and became director in 1935. He will be succeeded by **Dr. Cyril S. Fox.**

David A. Moffat, of Salt Lake City, vice-president of Utah Copper Company, has been elected chairman of the Western Division of the American Mining Congress.

C. R. Whittemore has been elected chairman and **Dr. A. Stansfield** reelected honorary chairman of the Montreal Chapter of the American Society of Metals.

Murray Willington, formerly underground manager of Raub Australian Gold Mining Company, Ltd.. Pahang. F. M. S., has joined the staff of Mount Kasi Mines, Ltd., Mount Kasi, Fiji.

J. A. Lyon, engineer formerly of Denver, is in charge of work in connection with the rehabilitation of the Lucky Boy silver-lead mine near Hawthorne, Nev.

C. H. Burgess resigned from the geological department of the Anaconda Copper Mining Company in September last and has opened a consulting office at Room 204, 14 West Granite St., Butte, Mont.

Philip F. Fix is returning to Yellowstone National Park for the sixth summer, as ranger-naturalist with the National Park Service, where his work is primarily the explanation of geological phenomena to visitors.

J. M. Ehrhorn, as consulting engineer, and **Army Adams,** as superintendent, are rehabilitating the Poverty Hill mine, the big ancient channel of the Port Wine flow. The property is in Yuba County, Calif.

Sir Evan Williams has been reelected president of the Mining Association of Great Britain, a position he has held for 21 years. **Sir Walter Benton Jones** was made vice-president.

Brian Hogg has been appointed manager of the Blue Spec mine, at Nullagine, Western Australia. He was formerly metallurgist at the Hannans North mine of Broken Hill Proprietary, Kalgoorlie.

John Austin, former superintendent of Jones Pass water diversion tunnel at Empire, Colo., has been made superintendent of the New Carlton tunnel and **A. H. Bebee** has been made general manager of the Carlton interests.

Merle H. Guise has been examining a number of placer properties in Idaho and will soon leave his headquarters in Seattle for Yukon Territory and Alaska, to continue examination of dragline and dredging ground.

L. J. Joubert has resigned the position of general manager of Bulolo Gold Dredging, Ltd., on account of ill health and has returned to the United States. **O. B. Hart** has been appointed acting general manager.

R. B. Woakes has been appointed general manager of Lake George Mines, Ltd., Captain's Flat, New South Wales, resigning from a position with the Indian Copper Corporation, Ltd., to accept the appointment.

Ellis H. Davies, chief engineer of Charles Ruwolt Pty., Ltd., manufacturers of mining machinery and general engineers, has left Australia for a business visit overseas. He will be away about six months.

M. V. Weatherall, consulting mining geologist, Kalgoorlie, has left for a visit to Canada and the United States, and plans to make a study of modern technique in structural geology as applied to mining.

J. C. Alexander, mine superintendent of the United Paracale Mining Company, Paracale, Camarines Norte, Philippine Islands, is now acting general superintendent during R. H. Canon's visit to the United States.

Earl C. Herkenhoff has left his position with the Phelps Dodge Corporation at Morenci, Ariz., and is now employed as an assistant engineer for the Anaconda Copper Mining Company at Butte, Mont.

Raymond Gunnar Nordstrom, of the University of Pittsburgh, has been awarded the joint fellowship of the University of Pittsburgh and the American Scandinavian Foundation, to study metallurgy in Sweden.

Howard I. Young, president of American Zinc, Lead & Smelting Company, was on May 23 awarded the honorary degree of doctor of engineering by the University of Missouri School of Mines, at Rolla, Mo.

Louis S. Cates, president of Phelps Dodge Corporation, has been continued as a member of the executive committee of the National Industrial Conference Board, meeting in New York on May 25.

A. D. Hughes sailed from San Francisco on June 2 for the Orient. For the next six months he will be acting resident manager of the Yukon-Pacific Mining Company, P. O. Box 292, Kuala Lumpur, Federated Malay States.

William Faust, of Ruby, Ariz., recently went to Argentina to join the force of the St. Joseph Lead Company at the company's lead-zinc mine in the Province of Jujuy, the property of its Argentine subsidiary, Compañia Minera Aguilar, S. A.

Frank A. Forward, of the department of mining, University of British Columbia, will spend the summer months in Ontario as a consultant in connection with the construction and initial operation of a sintering plant by Algoma Ore Properties at Sault Ste. Marie.

Courtney E. Cleveland, now engaged in post-graduate studies at McGill University, has been awarded the Barlow Memorial Prize of the Canadian Institute of Mining and Metallurgy for his paper, "Geology of the Bralorne and Pioneer Mines, Bridge River, B. C."

Dr. Curtis L. Wilson, professor of metallurgy at Montana School of Mines, will be in charge of the annual senior trip of the senior class of the University, during the course of which 32 students will make an 8,500-mile inspection tour of mines, mills, smelters and industrial plants.

George E. Connolly, chief engineer of Pacific Foundry, Ltd., San Francisco, was the photographer who took the picture of the 20-ton Herreshoff furnace and condensing system at the Great Western quicksilver mine, that appeared on page 46 of the April issue. Credit was accidentally omitted.

S. Frank Hunt, discoverer of the Rio Tinto mine at Mountain City, Nev., returned recently by airplane from a vacation in the Hawaiian Islands. He has made available additional funds for the Hunt Foundation, established by the 76-year-old pioneer for field instruction of students of the Mackay School of Mines at Reno.

J. H. Marsman, lately arrived from the Philippines, has been in Nevada recently. He was the guest at Reno of **J. O. Greenan,** who is operating at several points in the State and who for a number of years was consulting engineer for Marsman companies in the Philippines and elsewhere in the Orient. Accompanying him and visiting several of the Greenan projects were **J. O. Enberg,** head of the Marsman engineering staff, and **George Newman,** geologist for the same interests.

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OBITUARY

Alexander Moffatt Wilson, a pioneer mining man of California, died at Oroville, in that State, on April 6 at the age of 75.

Ferdinand Dietzsch, a consulting mining engineer of London, and a specialist in the metallurgy of lead and zinc, died last February at the age of 71.

W. W. Waggonner, mining engineer of Nevada City, Calif., and a noted authority on hydraulic mining, died in Nevada City on May 18 at the age of 79.

C. L. Green, long interested in the tin-mining industry of the Federated Malay States, and vice-president of the F.M.S. Chamber of Mines, died recently in Malaya.

J. Warner Allen, of Elizabeth, N. J., secretary and treasurer of several subsidiary companies of the Anaconda Copper Mining Company, died in Elizabeth on May 10. He was 63.

George Worthington, formerly superintendent of the Norambagua mine of Campbell Grass Valley Mining Company, died at Grass Valley, Calif., on April 26.

James O. Gillice, well-known mine operator and formerly connected with Inspiration Consolidated Copper Company, Miami, Ariz., died April 25 in Oakland, Calif.

Mark B. Rascovich, a mining engineer of New York City, and president of the Andaray Gold Mining Company in Peru, died on May 4 aboard the Pacific Steam Navigation liner "Oropesa" while the ship was between Cuba and Bermuda. He was 51.

John Torrey Fuller, mining engineer, of Honesdale, Pa., formerly prominently identified with South African diamond mining and until his retirement some years ago chief engineer of the Aluminum Company of America, died in New York on May 18 at the age of 59.

Earnest Edward Marshall, who had in his early professional work taken a prominent part in the development of the mineral industries of Chile and Peru and who more recently had been with Broken Hill Proprietary in Melbourne, died on April 16 at the age of 61.

Dr. J. Edmund Woodman, professor emeritus of geology at New York University, who had taught in the University for 29 years, died on May 19 at the age of 65. Dr. Woodman had had a long and distinguished career in both professional geologic and pedagogic fields. He was a member of many professional societies, including the Geological Society of America.

Thomas M. Kekich died in Los Angeles on May 21. He was born in Croatia in 1868 and came to the United States as a young man of seventeen. For 50 years thereafter he followed non-ferrous smelting and as a metallurgist and engineer worked in many well-known plants in the United States and abroad. He was responsible for the design and operation of blast furnaces in Yugoslavia, Mexico, and Russia and had patented many improvements in blasting and refining.

Caroline Hawxhurst Sharpless, wife of Frederick F. Sharpless, a mining engineer of national prominence until his retirement some years ago, died on May 15 at their home at Westbury, L. I. Mrs. Sharpless was an amateur explorer and surveyor, having mapped the wilds of British Columbia twenty years ago. In 1919 she led an expedition to Lake Maligne, B. C., and her maps of the lake are still on file with the Canadian Government.

Dr. Arthur Edward Wells, a director of the American Cyanamid Company and manager of the Bebee Products division of the Company, died in Boston on May 24 at the age of 54. Dr. Wells was an alumnus of the Massachusetts Institute of Technology, and had served as a metallurgist with the American Smelting & Refining Company and the United States Bureau of Mines. In 1926 he became professor of metallurgy at Harvard University, joining American Cyanamid four years later.

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A LETTER

Costs at a Small Mine on the Mother Lode

The Editor:

RECENT LETTERS describing and setting forth costs in small mine operations have been most interesting. They prompt me to give a brief résumé of a minor Mother Lode job which blossomed and faded during the depths of the last depression.

The Montezuma and Nashville mines, at Nashville, near Placerville, Calif., had been operated at various times in the past, the first of these instances being soon after the discovery of gold by Marshall at Coloma. It is said that one of the first stamp mills in California was erected here. The "old-timers" had worked the properties to the 900 level, and reports indicated that they had produced about $2,000,000 gross, which was probably exaggerated. However, in 1933, after the Montezuma mine had been unwatered and partly rehabilitated by other parties, we examined it, and, being overly gold-minded, inasmuch as lead, zinc, and copper were apparently drugs on the market, the venture was undertaken. After careful examination and sampling we believed that the property might produce ore containing ¼ to ⅓ oz. of gold per ton and that there was a sufficient amount of such ore available to warrant setting up a small mill with the reasonable expectancy of return of the cost of plant and the possibility of a small profit. Further hopes were based on downward continuation of oreshoots, as have been found in the Sutter Creek-Jackson areas.

The gold values in the exposed ore faces were spotty and assays ranged from nil to several ounces per ton. These averaged satisfactorily but were not sufficiently discounted because, when mining operations began, we found that the values were indeed erratic and the ore did not contain nearly what had been anticipated. However, as development progressed and the workings were extended downward to the 1,200 level, additional ore was opened and it seemed that some part of the original expectations were to be justified. Nothing of commercial value, however, was found on either the 1,300 or 1,500 level, although a strong vein and abundant quartz with its attendant sulphide mineralization were present on the lower level.

Period of operation—1933–1936, 38 months.
Ore mined and milled—171,139.
Average monthly production 4,500 tons.

COSTS	Per Ton
Mining	$1.75
Hoisting and tramming	0.52
Pumping	0.16
Development and exploration	1.10
Milling	1.04
General expense	0.15
Total operating cost at mine	$4.72

Recovered Ore Values

	Gold Ounces per Ton of Crude Ore	Per Cent Recovery	Value per Ton Crude Ore
Concentrate	0.072	40.67	$1.78
Bullion	0.089	50.28	$3.10
	0.161	90.95	$4.88
Tailing	0.016	9.05	
Heads	0.177	100.00	

Gold in bullion, net value per ounce, $34.74.
Gold in concentrate, net value per ounce, $24.59.
Ratio of concentration, 31.68 to 1.

The general conditions were similar to those found in many mines along the Mother Lode. The country rock was Mariposa formation, shales, slates, and sandstones, with minor greenstone inclusions, locally twisted and folded but generally coursing north-south with steep easterly dips. The vein was a strong fissure, striking northeasterly, dipping east at 65 deg. and from this branched two hanging-wall spurs. Most of the ore was found in the spur veins close to their junction with the main vein and in the main vein between the spurs. The total length of developed area along the strike of these structures was about 2,000 ft.

Along this vein and in the spur veins were irregular quartz deposits which ranged from massive bodies of 30 ft. or more in thickness to narrow sheet-like bands and stringers. Much or most of this quartz was barren of commercial gold values. Throughout the vein and in the quartz, there was more or less sulphide mineralization—pyrite, arsenopyrite, and small amounts of chalcopyrite, galena and sphalerite—and ever present along the footwall was the usual heavy, black, clay-like Mother Lode gouge, 2 to 10 ft. thick. The gold values were usually found directly above the gouge in narrow-ribboned quartz bands or stringers, but in places commercial ore spread over a width of 10 ft. or more.

The principal entry was a winding, two-compartment, inclined shaft which had been started to follow the vein; it was not good but usable. Levels had been spaced at approximately 100 ft. intervals. The extreme tramming distance was about 1,000 ft., but most of the ore was found within 500 ft. of the shaft. Hoisting was done with a single-drum hoist and a 2-ton skip. Pumping involved moving about 100 g.p.m. All openings along the vein required close timbering, local pine and fir being used. Stoping widths averaged about 5 ft. Wherever possible, waste rock from development was used for stope filling.

Milling was simple: primary crushing in a Blake-type crusher followed by a fine grinding in a 64½ Marcy ball mill in closed circuit with a Dorr classifier; 50 per cent of the gold was recovered in a hydraulic trap and a unit flotation cell between the ball mill and classifier; 40 per cent was recovered in flotation concentrate after the classifier. The trap and unit cell products were amalgamated by batch barreling and the gold content was converted to bullion. The flotation concentrate was shipped to the smelter. Carbonaceous gangue precluded cyanidation of either the crude ore or the concentrate.

Costs of miscellaneous data are given in the accompanying table.

These are average results covering the entire period of operation. When the tenor of the ore was better, (0.20 to 0.30 oz.), recoveries, both metallurgical and monetary, were better because the higher values were in readily recoverable, coarse, free gold, which was converted into bullion. On the other hand, when there was an extraordinary amount of gouge in the ore, milling results were poorer.

Thus, another paragraph in the history of the Mother Lode was written and may it be of some value to future engineers and potential investors in this area.

The lesson learned was, first, that sampling results must be discounted liberally, at least 25 per cent; second, that the "old-timers" left very little ore that can be worked profitably now, even with the increase in price and better metallurgy—they operated on ores to unbelievably low limits; third, property owners should take royalty for purchase price out of net profits, not out of gross proceeds, which would be somewhat revolutionary.

Of course, there was no net profit, as the margin between operating costs and ore values was so slim that it would not cover the fixed royalties to the land owners, to say nothing of depreciation and interest on plant expenditures. However, it will be noted that of the total operating costs of $4.72 per ton, $1.10 per ton was for development and exploration, which represents 15,658 ft. at $12.08 per foot, or $189,200, a liberal expenditure—perhaps too liberal.

J. A. NORDEN

Summary of the

MARKETS

BUYING of major non-ferrous metals during May was in fair volume, but prices realized averaged a little lower for the month on copper and lead, with zinc unchanged and tin higher. The *E.&M.J.* index of prices for May was 73.61, which compares with 74.79 in April and 69.15 in May last year. A feature in the market was the better tone in London, reflecting lessened tension over the European political situation.

Domestic trade in copper increased whenever the foreign and domestic prices attained parity. Sales for the month of May totaled 59,519 tons, which compares with 59,874 tons in April. Kennecott reduced its quotation to 10c., Valley, on May 8. This action served to bring the domestic quotation in line with the European price. Offerings of copper in the "outside" market diminished. The publication of the April statistics, showing another gain in stocks, unsettled the foreign market, and buying here quieted down. Late in the month the London price improved, which inspired more domestic business. A firm situation in domestic copper is not likely to occur until production and consumption are at least in balance, operators believe.

Lead sales were fairly large and the undertone of the market was firm, but producers were unable to lift the quotation because of the low prices obtaining abroad.

Interest in zinc centered in the moderate advance in London late in the month. However, the advance abroad has not been sufficient to influence the domestic quotation of 4½c., St. Louis, established here on Nov. 29. The British raised the duty on non-Empire zinc on May 26.

Negotiations are still on to barter wheat and cotton for tin.

The Italian-Spanish quicksilver combine has been renewed, according to London advices.

UNITED STATES MARKET

1939	Electrolytic Copper		Straits Tin	Lead		Zinc
May	Domestic (a) Refinery	Export (b) Refinery	New York	New York	St. Louis	St. Louis
1	10.025	9.825	49.250	4.75	4.60	4.50
2	10.025	9.775	49.250	4.75	4.60	4.50
3	10.025	9.775	49.350	4.75	4.60	4.50
4	10.025	9.800	49.250	4.75	4.60	4.50
5	10.025	9.800	49.250	4.75	4.60	4.50
6	10.025	9.800	49.250	4.75	4.60	4.50
8	9.775	9.825	49.125	4.75	4.60	4.50
9	9.775	9.750	49.150	4.75	4.60	4.50
10	9.775	9.775	49.300	4.75	4.60	4.50
11	9.775	9.825	49.250	4.75	4.60	4.50
12	9.775	9.800	49.000	4.75	4.60	4.50
13	9.775	9.775	48.875	4.75	4.60	4.50
15	9.775	9.750	48.875	4.75	4.60	4.50
16	9.775	9.750	48.875	4.75	4.60	4.50
17	9.775	9.675	49.000	4.75	4.60	4.50
18	9.775	9.625	48.850	4.75	4.60	4.50
19	9.775	9.625	48.850	4.75	4.60	4.50
20	9.775	9.625	48.850	4.75	4.60	4.50
22	9.775	9.625	48.800	4.75	4.60	4.50
23	9.775	9.625	48.700	4.75	4.60	4.50
24	9.775	9.625	48.800	4.75	4.60	4.50
25	9.775	9.650	48.900	4.75	4.60	4.50
26	9.775	9.725	49.000	4.75	4.60	4.50
27	9.775	9.725	49.000	4.75	4.60	4.50
29	9.775	9.725	49.000	4.75	4.60	4.50
30	Holiday	9.800	Holiday	Holiday	Holiday	Holiday
31	9.775	9.850	49.000	4.75	4.60	4.50
AVERAGES FOR MONTH						
	9.833	9.738	49.031	4.750	4.600	4.500
AVERAGES FOR WEEK						
3	10.025	9.829	49.133	4.750	4.600	4.500
10	9.900	9.792	49.221	4.750	4.600	4.500
17	9.775	9.763	48.979	4.750	4.600	4.500
24	9.775	9.625	48.808	4.750	4.600	4.500
31	9.775	9.746	48.980	4.750	4.600	4.500
CALENDAR WEEK AVERAGES						
6	10.025	9.796	49.267	4.750	4.600	4.500
13	9.775	9.792	49.117	4.750	4.600	4.500
20	9.775	9.675	48.883	4.750	4.600	4.500
27	9.775	9.663	48.867	4.750	4.600	4.500

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

1939	Sterling Exchange		Silver		Gold	
May	"Checks"	"90-day demand"	(c) New York	London	London	(d) United States
1	4.678750	4.652500	42.750	20.1875	148s 6d	$35.00
2	4.680000	4.656250	42.750	20.3125	148s 6d	35.00
3	4.678750	4.656875	42.750	20.2500	148s 5½d	35.00
4	4.678750	4.657500	42.750	20.2500	148s 6d	35.00
5	4.679375	4.659375	42.750	20.2500	148s 6d	35.00
6	4.678750	4.662500	(e)	20.3750	148s 6d	35.00
8	4.680000	4.662500	42.750	20.3125	148s 6d	35.00
9	4.680000	4.665000	42.750	20.1875	148s 5½d	35.00
10	4.680000	4.665625	42.750	20.0625	148s 5½d	35.00
11	4.680000	4.666250	42.750	20.1250	148s 5d	35.00
12	4.680000	4.665625	42.750	20.0625	148s 5½d	35.00
13	4.680000	4.666250	(e)	20.0625	148s 5½d	35.00
15	4.681250	4.666875	42.750	20.1250	148s 5½d	35.00
16	4.680000	4.665000	42.750	20.1250	148s 5d	35.00
17	4.680000	4.666250	42.750	20.1250	148s 5½d	35.00
18	4.679375	4.665000	42.750	20.0625	148s 6d	35.00
19	4.679375	4.665000	42.750	20.1250	148s 6d	35.00
20	4.680000	4.665625	(e)	20.0625	148s 6d	35.00
22	4.680000	4.664375	42.750	20.1250	148s 5½d	35.00
23	4.680000	4.665000	42.750	20.0625	148s 5½d	35.00
24	4.680000	4.665000	42.750	20.0625	148s 5d	35.00
25	4.680000	4.665000	42.750	20.0000	148s 5½d	35.00
26	4.680000	4.665625	42.750	20.0000	148s 5½d	35.00
27	4.680000	4.665000	(e)	19.9375	148s 5½d	35.00
29	4.681250	4.666875	42.750	Holiday	Holiday	35.00
30	Holiday	Holiday	Holiday	20.0000	148s 5½d	Holiday
31	4.681250	4.666250	42.750	19.9375	148s 5½d	35.00
Average for Mo.	4.67988	.....	42.750	20.123	.....	35.00
AVERAGES FOR WEEK						
May						
3	4.67875	.....	42.750	.....	.....	.....
10	4.67948	.....	42.750	.....	.....	.....
17	4.68021	.....	42.750	.....	.....	.....
24	4.67979	.....	42.750	.....	.....	.....
31	4.68050	.....	42.750	.....	.....	.....

Calendar week averages: New York Silver May 6th, 42.750; 13th, 42.750; 20th, 42.750; 27th, 42.750.

(e) Not quoted; Saturday.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.325c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order effective Jan. 1, 1939, the U. S. Government's price on newly mined domestic silver was continued at 64.64c. Handy & Harman's quotation for domestic silver, 999 fine, was 64⅛c. per ounce throughout May.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1939 May	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
1	41.8125	42.1250	47.7500	225.2500	223.0000	14.4375	14.5000	14.7500	14.8125	13.5000	13.5625	13.8125	13.8750
2	41.5000	41.8750	47.2500	224.7500	222.5000	14.3750	14.4375	14.6250	14.6875	13.3750	13.5000	13.6875	13.7500
3	41.6875	42.0000	47.5000	225.2500	222.7500	14.3750	14.4375	14.6250	14.6875	13.5000	13.5625	13.7500	13.8750
4	41.8750	42.2500	47.7500	225.5000	222.7500	14.3750	14.4375	14.6250	14.6875	13.5000	13.5625	13.8125	13.8750
5	42.0000	42.3750	47.7500	225.2500	222.7500	14.3125	14.4375	14.5625	14.6250	13.5625	13.6250	13.8125	13.8750
8	41.8750	42.1250	47.7500	225.0000	222.5000	14.3750	14.5000	14.5625	14.6875	13.6875	13.7500	13.9375	14.0000
9	41.4375	41.6875	47.2500	224.5000	222.2500	14.3750	14.5000	14.5625	14.6250	13.6250	13.6875	13.8750	14.0000
10	42.0625	42.3750	47.7500	225.5000	223.0000	14.6250	14.6875	14.8125	14.8750	13.7500	13.8125	14.0000	14.0625
11	42.0000	42.3125	47.7500	226.0000	223.5000	14.5625	14.6875	14.8125	14.8750	13.7500	13.8125	14.0625	14.1250
12	41.6250	41.9375	48.1250	225.0000	222.5000	14.5000	14.6250	14.7500	14.8125	13.6875	13.8125	14.0000	14.0625
15	41.6250	42.0000	48.0000	225.2500	222.7500	14.5625	14.6875	14.8125	14.9375	13.5625	13.6250	13.8750	14.0000
16	41.3125	41.6875	47.2500	225.7500	223.2500	14.5000	14.5625	14.7500	14.8125	13.5000	13.5625	13.7500	13.8125
17	41.0000	41.3125	47.0000	225.2500	223.0000	14.3750	14.4375	14.6250	14.6875	13.4375	13.5625	13.7500	13.8125
18	40.8750	41.2500	47.3750	225.5000	223.0000	14.3125	14.3750	14.5000	14.5625	13.4375	13.5000	13.7500	13.8125
19	41.1250	41.5000	47.0000	226.0000	223.5000	14.3125	14.3750	14.5000	14.5625	13.5000	13.5625	13.8125	13.8750
22	41.1875	41.5000	47.2500	226.0000	223.5000	14.3125	14.4375	14.5625	14.6250	13.6250	13.6875	13.8750	13.9375
23	41.3750	41.7500	47.3750	225.2500	223.5000	14.3125	14.3750	14.5000	14.5625	13.6875	13.7500	13.9375	14.0000
24	41.1250	41.5000	46.7500	226.0000	223.7500	14.3125	14.3750	14.5000	14.5625	13.8750	13.9375	13.9375	14.0000
25	41.8125	42.1250	47.2500	225.7500	223.7500	14.3750	14.5000	14.5625	14.6250	13.9375	14.0625	14.0000	14.0625
26	42.1250	42.5000	47.5000	226.5000	224.2500	14.6250	14.6875	14.6875	14.7500	14.0625	14.1875	14.0625	14.1875
29	Holiday												
30	42.2500	42.6250	47.7500	226.5000	224.3750	14.6250	14.7500	14.6875	14.7500	14.1250	14.2500	14.1250	14.1875
31	42.7500	43.1250	48.5000	227.2500	225.0000	14.6875	14.8125	14.8125	14.8750	14.1875	14.3125	14.1875	14.2500
Average for Month	41.656	.....	47.528	225.591	.....	14.483		14.679		13.717		13.938	

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers prices. All are in pounds sterling per long ton of 2,240 lb.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(June 1, 1939)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	20c.
Antimony, domestic, spot, lb	12.00c.
Bismuth, ton lots, lb	$1.10
Cadmium, commercial sticks, lb	50c.
Calcium, lb., ton lots 97 @ 98 per cent	75c.
Chromium, 97 per cent grade, lb	85c.
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carolads, lb	28c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$35.00
Quicksilver, flask of 76 lb., 100 flasks or more	$84.00@$86.00
Radium, mg. radium content	$40.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	$19.50@$20.50
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent, Joplin, Mo., ton	$52.00@$56.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit of Mn:	
52 @ 55 per cent	29c.
50 @ 52 per cent	28c.
44 @ 48 per cent	24c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	$18.50
Domestic, 65 per cent and upward	(a)$15.00@$17.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$30.00

(a) Prices at mines, small lots, usually several dollars less.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.67@$1.77
Copper Sulphate, 100 lb	$4.15
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$13.00@$15.00

ALLOYS

Berrylium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	10½c.
Ferromanganese, 78 @ 82 per cent, gross ton	$80.00
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.60

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$12@$16.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$7.00
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.00@$7.00
Domestic, abrasive, 80 @ 84 per cent	$12.00@$14.00
Dalmatian, 50 @ 55 per cent	(a)$6.00@$7.00
French, 56 @ 59 per cent	(a)$7.00@$8.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$18.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in	25@30c.
2 x 2 in	40@50c.
3 x 3 in	75@80c.
3 x 4 in	$1.00@$1.20
3 x 5 in	$1.60@$1.70
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	12c.
Silica, in bags, 325 mesh, ton	$18.00@$40.00
Sulphur, Texas mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$21.50
Basic	$20.50
No. 2 Foundry	$21.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1938	1939	1938	1939	1938	1939
January	44.750	42.750	19.895	20.305	499.895	466.775
February	44.750	42.750	20.159	20.370	501.722	468.472
March	44.446	42.750	20.088	20.280	498.394	468.370
April	42.750	42.750	18.880	20.031	498.046	467.778
May	42.750	42.750	18.731	20.123	496.673	467.988
June	42.750	.....	18.945	.....	495.772	.....
July	42.750	.....	19.356	.....	492.855	.....
August	42.750	.....	19.389	.....	488.044	.....
September	42.750	.....	19.300	.....	480.240	.....
October	42.750	.....	19.613	.....	476.785	.....
November	42.750	.....	19.834	.....	470.587	.....
December	42.750	.....	20.083	.....	466.798	.....
Year	43.225	.....	19.523	.....	488.818	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London, pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic, Domestic		F.O.B. Refinery, Electrolytic, Export		London Spot, Standard		London Spot, (a) Electrolytic	
	1938	1939	1938	1939	1938	1939	1938	1939
January	10.198	11.025	9.908	9.912	41.387	43.125	45.387	48.440
February	9.775	11.025	9.525	9.735	39.597	42.188	43.563	47.375
March	9.775	11.025	9.496	9.888	39.772	42.938	43.582	48.120
April	9.775	10.265	9.443	9.820	39.306	42.031	43.408	47.833
May	9.375	9.833	8.801	9.738	36.668	41.656	40.852	47.528
June	8.775	.....	8.500	.....	35.235	.....	39.417	.....
July	9.585	.....	9.573	.....	39.744	.....	44.405	.....
August	9.900	.....	9.844	.....	40.591	.....	45.909	.....
September	10.028	.....	9.943	.....	41.864	.....	47.148	.....
October	10.760	.....	10.713	.....	45.646	.....	51.190	.....
November	11.025	.....	10.569	.....	45.244	.....	51.080	.....
December	11.025	.....	10.023	.....	43.428	.....	48.988	.....
Year	10.000	.....	9.695	.....	40.707	.....	45.411	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1938	1939	1938	1939	1938 Spot	1938 3 mos.	1939 Spot	1939 3 mos.
January	4.870	4.826	4.720	4.676	16.135	16.253	14.534	14.744
February	4.632	4.805	4.482	4.655	15.402	15.525	14.283	14.417
March	4.500	4.824	4.350	4.674	15.992	16.075	14.660	14.860
April	4.500	4.782	4.350	4.632	15.579	15.623	14.337	14.533
May	4.400	4.750	4.250	4.600	14.210	14.376	14.483	14.679
June	4.148	.....	3.998	.....	13.969	14.012	.....	.....
July	4.882	.....	4.732	.....	14.921	15.034	.....	.....
August	4.900	.....	4.750	.....	14.371	14.480	.....	.....
September	4.998	.....	4.848	.....	15.249	15.401	.....	.....
October	5.100	.....	4.950	.....	16.173	16.313	.....	.....
November	5.091	.....	4.941	.....	16.088	16.223	.....	.....
December	4.842	.....	4.692	.....	15.106	15.275	.....	.....
Year	4.739	.....	4.589	.....	15.266	15.383	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits, New York		Standard, Spot, London	
	1938	1939	1938	1939
January	41.548	46.404	183.619	215.435
February	41.373	45.640	183.144	213.906
March	41.219	46.213	183.473	215.375
April	38.430	47.160	168.612	218.389
May	36.885	49.031	162.693	225.591
June	40.376	.....	177.429	.....
July	43.428	.....	192.542	.....
August	43.276	.....	192.966	.....
September	43.369	.....	193.733	.....
October	45.263	.....	206.911	.....
November	46.262	.....	213.909	.....
December	46.180	.....	214.450	.....
Year	42.301	.....	189.457	.....

New York quotations cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1938	1939	1938 Spot	1938 3 mos.	1939 Spot	1939 3 mos.
January	5.000	4.500	14.994	15.173	13.682	13.887
February	4.813	4.500	14.408	14.589	13.522	13.780
March	4.417	4.500	14.364	14.477	13.728	13.961
April	4.141	4.500	13.729	13.919	13.443	13.637
May	4.042	4.500	12.682	12.869	13.717	13.938
June	4.131	.....	12.890	13.104	.....	.....
July	4.745	.....	14.144	14.371	.....	.....
August	4.750	.....	13.467	13.675	.....	.....
September	4.846	.....	14.040	14.246	.....	.....
October	5.012	.....	15.083	15.232	.....	.....
November	4.924	.....	14.366	14.550	.....	.....
December	4.500	.....	13.709	13.861	.....	.....
Year	4.610	.....	13.990	14.172	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pounds sterling per long ton.

CADMIUM AND ALUMINUM

	Cadmium			Aluminum	
	1938 (a)	1939 (a)	1939 (b)	1938	1939
January	117.500	70.900	58.400	20.000	20.000
February	117.500	67.500	55.000	20.000	20.000
March	117.500	65.278	54.259	20.000	20.000
April	102.500	52.500	50.000	20.000	20.000
May	102.500	52.500	50.000	20.000	20.000
June	102.500	.....	.....	20.000	.....
July	102.500	.....	.....	20.000	.....
August	99.722	.....	.....	20.000	.....
September	84.000	.....	.....	20.000	.....
October	80.000	.....	.....	20.000	.....
November	77.717	.....	.....	20.000	.....
December	72.500	.....	.....	20.000	.....
Year	98.037	.....	.....	20.000	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound; (a) average of producer's and plater's quotations; (b) producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1938	1939	1938	1939	1938	1939
January	13.750	11.670	79.240	77.440	36.000	34.440
February	13.750	11.250	76.455	85.227	36.000	35.000
March	13.750	11.269	72.444	87.278	36.000	35.000
April	13.654	11.500	71.019	90.800	36.000	35.000
May	12.460	11.712	74.640	86.769	33.400	35.000
June	11.731	.....	80.731	.....	33.231	.....
July	11.030	.....	76.860	.....	36.000	.....
August	10.880	.....	75.500	.....	37.000	.....
September	11.310	.....	74.420	.....	39.000	.....
October	12.060	.....	73.480	.....	37.960	.....
November	12.250	.....	74.065	.....	36.217	.....
December	11.567	.....	76.769	.....	34.000	.....
Year	12.349	.....	75.469	.....	35.901	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk deduct .250c. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum is dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1938	1939	1938	1939	1938	1939
January	24.50	21.50	23.50	20.50	24.00	21.00
February	24.50	21.50	23.50	20.50	24.00	21.00
March	24.50	21.50	23.50	20.50	24.00	21.00
April	24.50	21.50	23.50	20.50	24.00	21.00
May	24.50	21.50	23.50	20.50	24.00	21.00
June	23.73	.....	22.73	.....	23.23	.....
July	20.50	.....	19.50	.....	20.00	.....
August	20.50	.....	19.50	.....	20.00	.....
September	20.50	.....	19.50	.....	20.00	.....
October	21.50	.....	20.50	.....	21.00	.....
November	21.50	.....	20.50	.....	21.00	.....
December	21.50	.....	20.50	.....	21.00	.....
Year	22.686	.....	21.686	.....	22.186	.....

Iron, dollars per long ton. F. o. b. Mahoning and Chenango Valley furnaces.

What Metal Statistics Show

METAL PRODUCERS reflected a slight improvement in sentiment late in May and early June as a steadier undertone developed in general industry. Apprehension still persists, however, in many directions and some doubt prevails whether this improvement is sufficiently substantial to be of any duration. The *E. & M. J.* index of metal prices was 73.61 in May, against 74.79 in April.

A decline in the price of copper on May 8 from 10¼ to 10c. may force some reduction in output. The Steward mine of Anaconda Copper Mining Company in Butte suspended operations late in May. Stocks of refined copper in this country (duty-free metal) increased 11,702 tons in April. Mine output (blister) totaled 48,811 tons in April, against 50,626 tons in March.

A summary of the March and April statistics of the Copper Institute, in short tons, follows:

Production, crude:	March	April
U. S. mine	50,626	48,811
U. S. scrap, etc.	11,126	13,907
Foreign mine	90,122	86,386
Foreign scrap	12,435	11,173
Totals	(a)164,309	160,277
Production, refined:		
United States (b)	66,718	58,368
Foreign	105,780	107,940
Totals	(a)172,498	166,308
Deliveries, refined:		
U. S. domestic	50,803	42,484
U. S. exports (b)	4,222	4,183
Foreign	103,638	107,011
Totals	(a)158,663	153,678
Stock at end, refined:		
United States	320,812	332,513
Foreign	189,280	190,209
Totals	(a)510,092	522,722

(a) Corrected. (b) Duty-free copper.

▶ ZINC—Production of zinc during May totaled 42,302 tons, against 43,036 tons in April, but stocks increased 2,695 tons. Shipments to consumers in May totaled 39,607 tons (all grades), against 40,641 tons in April. The new zinc tariff is beginning to exert a depressive influence on the domestic zinc smelting industry. The United Zinc Smelting Corporation, Moundsville, W. Va., closed its plant late in May, throwing about 200 men out of work. The American Zinc Lead & Smelting Company has announced its intention of closing its East St. Louis slab zinc smelter. One furnace block is already shut down and complete closing may be effective by the end of June.

The March, April, and May statistics of the American Zinc Institute, covering all grades, are summarized as follows, in tons.

	Mar.	Apr.	May
Stock at beginning	128,192	127,985	130,380
Production	45,084	43,036	42,302
Production daily rate	1,454	1,435	1,365
Shipments	45,291	40,641	39,607
Unfilled orders	38,447	29,314	29,250
Stock at end	127,985	130,380	133,075

Figures covering operations of the Prime Western division, for March, April, and May, follow:

	Mar.	Apr.	May
Stock at beginning	54,214	56,522	57,558
Production	20,813	20,152	19,756
Shipments	18,505	19,116	18,506
Stock at end	56,522	57,558	58,805

▶ LEAD—Domestic mine output of lead is holding around 37,000 tons per month. Shipments to consumers in May are expected by the industry to approximate 40,000 tons, against 37,903 tons shipped in April.

Domestic shipments during April amounted to 37,903 tons. The quantity of lead shipped to domestic consumers in the first four months of the year averaged 38,348 tons monthly, against 30,516 tons monthly in the same period of 1938.

The refined-lead statistics for March and April, in short tons, according to the American Bureau of Metal Statistics, follow:

	March	April
Stock at beginning	122,112	122,035
Production:		
Domestic ore	37,790	36,704
Secondary and foreign	3,009	2,546
Totals	40,799	39,250
Domestic shipments	40,871	37,903
Stock at end	122,035	123,394

▶ TUNGSTEN—In 1938, 3,044 short tons of concentrated ore (reduced to an equivalent of 60 per cent WO_3) were shipped from domestic mines, compared with 3,500 tons in 1937. The average value per unit of the tungsten concentrates sold declined from $19.50 in 1937 to $17.31 in 1938. Shipments of tungsten concentrate were made from Arizona, California, Colorado, Idaho, Missouri, Nevada, New Mexico, Utah and Washington in 1938; Nevada retained its position as the largest tungsten producer.

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922-3-4)

1929	110.33	1934	69.59
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67

	1937	1938	1939
January	87.03	75.56	77.12
February	91.68	73.43	76.89
March	103.78	72.41	77.09
April	98.62	71.19	74.79
May	93.25	69.15	73.61
June	93.21	67.55	....
July	93.82	72.95	....
August	95.28	73.94	....
September	94.33	74.70	....
October	85.26	77.61	....
November	78.91	78.36	....
December	75.18	77.13	....

▶ Domestic shipments and imports of tungsten concentrate were lower in 1938 than in the preceding year, according to the United States Bureau of Mines. Domestic production, however, amounted to 4,000 short tons in 1938, against 3,500 tons in 1937. The domestic statistics for 1937 and 1938, in short tons, follow:

	1937	1938
Production (a)	3,500	4,000
Concentrate shipped (a)	3,500	3,044
Imported for consumption (b)	2,848	81

(a) Basis 60% WO_3. (b) W content.

The sharp decline in imports last year was attributed in market circles to overbuying in 1937, largely inspired by fears over the situation in China. Tungsten ore and concentrate imported for domestic consumption in 1937 and 1938, in pounds (gross weight), was as follows:

From:	1937	1938
Argentina	257,797	.....
Australia	566,522	.....
Belgium	95,200	.....
Bolivia	143,763	2,286
British Malaya	1,590,883	108,765
Br. South Africa, etc.	53,000	.....
Chile	18,700	.....
China	7,104,224	138,380
Hongkong	33,600	.....
Japan	111,152	.....
Mexico	89,763	27,585
Sweden	22,418	.....
Union of South Africa	102,603	45,069
Totals	10,189,625	322,085

▶ QUICKSILVER — Quicksilver production in the United States in 1938 amounted to 17,991 flasks, which compares with 16,508 flasks in 1937, according to the annual figures of the United States Bureau of Mines.

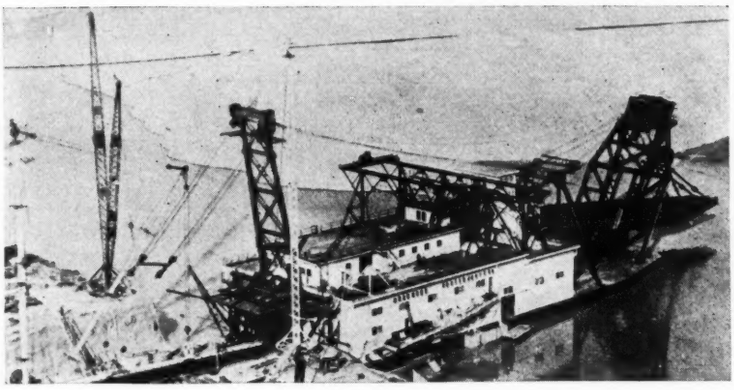
Imports for consumption in the United States fell from 18,917 flasks in 1937 to 2,362 flasks in 1938. Spain supplied 1,251 flasks and Italy 1,111 flasks. Increased production in the United States was due to greater output at the New Idria, Mount Diablo, Mirabel, Oat Hill, and Great Western mines of California, and the Bonanza mine, in Oregon. Fifteen mines produced 90 per cent of the country's output. Production in Texas was sharply lower.

Quicksilver production during the last two years, by states, in flasks of 76 lb., was as follows:

	1937	1938
Arizona	37	....
California	9,743	12,277
Nevada	198	336
Oregon	4,264	4,610
Other states (a)	2,266	768
Totals	16,508	17,991

(a) Includes Arkansas ,Texas, and Washington in 1937; and Alaska, Arkansas, Texas, and Washington in 1938.

Mines producing in 1938 totaled 91, which compares with 101 in 1937.



Capable of digging to a depth of 125 ft. below water level, this large dredge, known as Yuba No. 20, recently started operations near Marysville, Calif.

CALIFORNIA

Keystone Mining Syndicate Adds to Holdings

Original Amador Mining property purchased—California-Engels Mining Company testing gold-bearing gravel area in Plumas County—New dragline dredge begins operations near Valley Springs

▶ Keystone Mine Syndicate, Charles H. Segerstrom, president, has purchased the Original Amador mine holdings at Amador City, Amador County, controlled and formerly worked by Hamilton, Beauchamp & Woodworth, of San Francisco. The 350-ton mill available at the property will be enlarged and repaired to handle ore from the company's adjoining Keystone mines. T. S. O'Brien is superintendent.

▶ Drilling operations have started at the Engels mining properties, once California's largest copper producer, on 200 acres of the 4,500 acres owned by the California-Engels Mining Company at Engelmine, Plumas County. Examination of the property by Roger L. Beals, general manager, and M. A. Newman, mining engineer, San Francisco, with A. J. Heller, president, disclosed an ancient river channel traversing the mineral holdings. Several years ago three shallow shafts were sunk to the gravel, which showed some gold, but no effort was made further to explore the ground. Recently a Keystone drill has been installed to test the gravel area thoroughly. The work is carried out under the direction of M. A. Newman.

▶ Work has resumed at the Antelope mine, situated about 25 miles southeast of Tres Pinos, San Benito County, by H. V. Underwood and associates, all of Hollister. The mine is opened by three tunnels and a shallow shaft, and the ore contains copper, with some silver, gold and nickel.

▶ Burcham Mines, Inc., H. S. Kimball, president, is reported to have acquired under a lease and option contract the Burcham mine, in the Calico district near Daggett, San Bernardino County, and rehabilitation has started, with twelve men employed. The property was first worked by C. A. Burcham, one of the original owners of the Yellow Aster mine, at Randsburg, and is noted for its silver values. Granville Moore is general manager.

▶ A new 25-ton flotation plant is being constructed by L. W. Williams, of Grass Valley, Nevada County, on Deer Creek, where several claims are under exploration. Major development is centered on the Manila vein, intersecting between the Kentucky Ridge and Niagara veins. Mr. Williams also holds the J. Hamilton Smith and the Whitelaw Reid claims in addition to the Manila and Niagara properties. Water is obtained from a dam 70 ft. long and 14 ft. high completed recently.

▶ Capacity of the mill at the New York mine near Greenville, Plumas County, is being increased from 60 to 100 tons by the addition of new equipment. The plant, which also treats ore from the near-by Droege mine, is operated by North Canyon Mines, Inc., W. H. Parsons, general manager. A 400-ft. drift now being driven in the main tunnel is expected to open new oreshoots. About 50 men are employed.

▶ John Becker, who has been connected for many years with operations of the Newmont Mining Corporation both in the Grass Valley-Nevada City mining are and in South Africa, is reported to have purchased the Boundary mine, just south of Grass Valley. Rehabilitation includes reopening the old shaft, installation of mining machinery, and construction of a surface plant. Arthur Hellings is in charge of operations.

▶ The Oro Flame property, near Alleghany, Sierra County, is to be reopened soon by San Francisco interests which have obtained an option on the mine from J. J. Connell, the owner. The mine is opened by a 700-ft. tunnel and covers about 4½ claims.

▶ William E. Funk, of Stockton, Calif., has placed in operation a dragline dredge on the Smile Pacheco Ranch near Jenny Lind, Amador County.

▶ Satisfactory progress is being made in the erection of a cyanide-flotation plant at the old Plymouth mine, at Plymouth, Amador County, owned by the Argonaut Mining Company, Ltd., to treat accumulated tailings. The equipment to be installed is that of the 600-ton plant of Central Tailings Company now being dismantled at Sutter Creek. This unit until three years ago handled the tailings of the mill of Central Eureka Mining Company. H. M. Lewers, superintendent, is in charge of operations at the Plymouth mine.

▶ At the E. R. Skinner gravel mine, a short distance west of Rescue, a new treatment plant capable of handling from 200 to 250 yd. of gravel a day was placed in operation recently. The property is operated by Thomas B. Sturgess, of Pittsburgh, Pa., with A. L. Chappel directing the work.

▶ About 80 tons of ore a day are now being treated at the mill operating on the Surcease property following completion of a development program and installation of milling machinery. A new orebody is reported to have been opened up on the 600 level, and ore is treated by cyanide-flotation methods. Hoefling Brothers, of Sacramento, are the owners of the mine, which is near Oroville. About 70 men are employed under A. E. Jones, general manager.

▶ Warwin Mines, Inc., is developing the Mormon Hill mine, near Rescue, and has completed installation of modern recovery equipment at the stamp mill available at the property. Development consists of two shaft and several hundred feet of drifts. H. Kaufman is president of the company, and W. Covey, manager.

▶ C. L. Best, operator of the Ruby mine, at Downieville, Sierra County, is reported to have leased the Pilot property adjoining the Ruby and plans to work the mine as soon as weather conditions permit. B. C. Austin, of San Francisco, is consulting engineer for the Best interests, and L. L. Huelsdonk, manager, directs operations at the Ruby mine.

▶ A dragline dredge, consisting of a 3-yd. digging unit and a floating washing plant and capable of handling 5,000 yd. of gravel per day, has been placed in operation near Valley Springs by Lord and Bishop, of Sacramento.

NEVADA

New Cyanide Plant for Property in Nye County

Low-grade gold deposit will be exploited by open-cut methods—Lucky Boy silver-lead mine being rehabilitated—Expansion in gold placer mining under way in some districts

▶ Following several months of test work with the use of churn drills, a low-grade gold property east of the old camp of Northumberland, in northern Nye County, has been acquired by a group headed by Walter Haggerty, of Beverly Hills, Calif., formerly of New York, who have composed the Weepah Nevada Mining

Trailer batteries... a novel idea, and a great success in this mine

PARK UTAH CONSOLIDATED MINES COMPANY

KEETLEY, UTAH

Dec. 22, 1938

The Electric Storage Battery Co.,
810- 14th. St.,
Denver, Colo.

Gentlemen:

After some thirty years of use of trolley locomotives of two, four and eight tons in the mines of the Park Utah Consolidated Mines Company, we initiated the installation of Exide Ironclad Battery units in December 1937, under the advice of our consulting engineer.

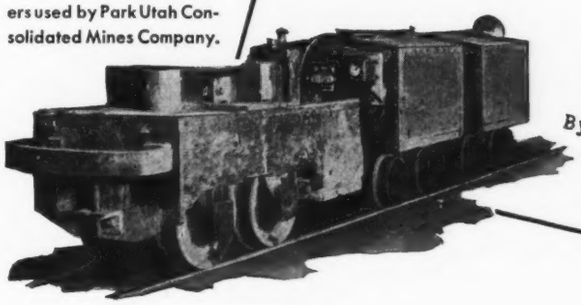
The somewhat novel practice was adopted of using trailer batteries, which permitted the combined unit to be designed for full load hauling at high speed, with ample storage capacity for eight hours operation.

The operating results were satisfactory in every respect and it is our intention to continue the development of Exide Battery haulage.

Very truly yours,

PARK UTAH CONSOLIDATED MINES CO.
By Paul [illegible]
Mine Manager

Showing the battery trailers used by Park Utah Consolidated Mines Company.



IT is perhaps not in every mine that the plan of using trailer batteries would fit into the haulage picture. It is obviously an excellent solution for exceptionally tough requirements. But every mine can benefit materially by the use of Exide-Ironclad Batteries. Their performance and dependability combine to increase production by means of speedier haulage.

Exide-Ironclads, with their high power ability for unusual loads and grades, with their sustained voltage for continued good haulage speeds, and with their famous dependability for minimizing interruptions in the service—can consistently help you to haul more ore per hour and per day.

Exide
IRONCLAD
BATTERIES
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"MIPOR," Reg. U. S. Pat. Off.

These batteries are economical. They last so long that in most cases they considerably outlast their guarantee. They stay on the job and out of trouble, month in and month out. Is it any wonder that they are the most widely used batteries in underground haulage service today? Write for free booklet, "The Storage Battery Locomotive for Underground Haulage."

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
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▶NEVADA

Company, operating at Weepah, Esmeralda County. At the newly acquired property a cyanide mill of 250 to 300 tons' capacity is to be constructed at once, equipment to be supplied by the Southwestern Engineering Company. Three diesel engines with combined capacity of 750 hp. have been ordered from the Chicago Pneumatic Tool Company for delivery within 30 days. J. C. Perkins is Nevada manager for the group and Erich J. Schrader consulting engineer. The deposit is described as a bed of shattered and silicified schist lying on limestone, similar to that at Weepah but with little or no overburden, and will be mined by power shovels.

▶ Clearing and retimbering of the 6600-ft. deep-level haulage tunnel of the Lucky Boy silver-lead mine near Hawthorne, Mineral County, has been nearly completed and connections are reopened with the two main shafts. The 200-ton flotation mill is to be reconditioned and electric haulage equipment installed. The property has been acquired under lease and option by the Champion City Mines, Inc., headed by a group of Duluth and Minneapolis men, with L. E. Stein, of Hawthorne, president.

▶ A plan to reorganize the Nevada State Gold Mines, Inc., formerly the Seven Troughs Gold Mines Company, under Sec. 77-b of the Federal bankruptcy law, has been approved by Judge F. H. Norcross of the Federal District Court, and refinancing is said to be in progress. The company owns about 2,400 acres, including mines that have produced around $3,500,000, chiefly in gold, with a 12,000-ft. development tunnel, a 100-ton cyanide mill, diesel power plant, and camp equipment in the Seven Troughs district, Pershing County. Stuart L. Williams, of Lovelock, is secretary-treasurer and resident agent.

▶ Spring activities in Nevada have been marked by expansion in placer mining and in intensive testing of placer areas, some of these localities having attracted strong mining organizations. Pershing County fields, including Placeritos, Rabbit Hole, Sawtooth, and others, are centers of new activity. Three heavy-duty Keystone type drills have been employed in testing ground of the Greenan Placers, Inc., near Copper Canyon, Lander County, with satisfactory results. The Greenan company is operating a washing plant, partly on tailing from old sluice workings. Two large tracts near Battle Mountain and Tenabo have been acquired under option by the General Dredging Corporation, operating floating dredges near Folsom, Calif., and of which J. O. Greenan is vice-president and consulting engineer. Reports indicate early installation of a number of dragline land dredges or those of the "doodlebug" type in several Nevada districts.

▶ A crushing plant with diesel-power unit has been provided by the Basic Ores, Inc., at its brucite deposit near the Nye-Mineral County line. Heretofore the crude product has been trucked to Luning, a station on the Mina branch of the Southern Pacific Railroad, for rail shipment to Maple Grove, Ohio. Basic Ores, Inc., is an operating subsidiary of Basic Dolomite Company, with processing plants in Ohio. N. E. Hanson is manager of the Nevada properties.

▶ A bucket-line dredge completed during the winter on placer ground below Manhattan Gulch, in Nye County, by the Manhattan Gold Dredging Company, is washing around 12,000 cu.yd. of gravel per day with results that are reported satisfactory. Water is piped 9 miles from a ranch property purchased by the company. The Natomas company owns approximately 20 per cent of the project and receives a percentage of profit for its operation.

▶ Metallurgy of complex gold-silver-copper ore of the Ashdown mine, in northern Humboldt County, is being studied by Albert Silver, metallurgist of Tonopah, as a step preliminary to enlarging the present 25-ton flotation mill to 100 tons' capacity. The Ashdown mine, a producer at intervals over a period of 60 years, was acquired lately under option by James M. Curley, former Governor of Massachusetts, who has been at the property recently and who has organized the Curley Luck Gold Corporation to operate the mine. F. M. Maloney, with office at Winnemucca, is manager and local agent.

▶ The cyanide mill at the gold property of the Chiquita Mining Company, Ltd., near Goodsprings, Clark County, is treating around 80 tons per day, leading the southern part of Nevada in gold production. Reports indicate that orebodies of substantial volume have been developed on all levels to a depth of 1,000 ft. Plans to increase mill capacity to 300 tons per day were said to be under consideration. James Maxwell, of Las Vegas, Nev., is manager and J. J. Smith, of Goodsprings, superintendent.

▶ A crosscut from the 1,200-ft. station of the Caselton main shaft of the Combined Metals Reduction Company at Pioche, Lincoln County, has been extended over 4,000 ft. to a connection with another shaft. Company officers have indicated that construction of an 800-ton flotation mill at the Caselton shaft, and an electrolytic smelter near Boulder dam, planned for some time, must await higher metal prices. Controlling interest in Combined metals is owned by the National Lead Company; the minority interest by the Snyder group of Salt Lake City. Ed. H. Snyder is manager at Pioche.

▶ Concrete work has been completed for construction of a 600-ton cyanide mill for the Standard Cyaniding Company near the west base of the Humboldt range, 7 miles from Rye Patch, in Pershing County. The contract for mill construction was awarded to the Western Knapp Engineering Company. Roy Marcellus is in charge. Development, involving a cost of over $160,000, served to block 1,070,000 tons of ore sampling $2.10 gold per ton. The property was first acquired and developed by the Pacific Syndicate, composed chiefly of officers of the Standard Oil Company of California, under the direction of J. B. Stott, manager. Upon completion of the development plan it was transferred to the newly organized Standard Cyaniding Company, of which Howard L. Hazen, president and manager of the Caliente Cyaniding Company, operating at the old gold camp of Delamar, is president, and Henry Bradley, associated with the Standard Oil group in California, is vice-president. D. R. Fraser, long associated with President Hazen, is secretary and treasurer. The deposit, it was stated, can be worked to a depth of 250 ft. by power shovel and at low cost. An office has been opened at Lovelock.

UTAH

Two Mining Companies Reopen Properties

Silver King Coalition and Park City Utah Mines Company resume work after one-year shutdown—Development started by New Park Mining Company—North Lily ships high-grade gold ore

▶ Favorable developments continue to punctuate the trend of the Utah mining industry. Two of the largest silver-lead producers—the Silver King coalition and the Park Utah Consolidated Mines—resumed operations after a shutdown of one year. The Park City Utah Mines Company struck ore at depth, and shipments from the new strike in the North Lily mine continue. By resumption of work at the Silver King Coalition on May 8 and at the Park Utah Consolidated Mines on May 16, 550 miners laid off a year ago at Park City will find steady employment. Furthermore, the increase in the production of concentrate will allow the reopening of the Murray smelter of the American Smelting & Refining Company at Murray in the fall. M. G. Heitzman is manager of operations at the Silver King Coalition and James Ivers general manager; Paul H. Hunt is manager of mines at the Park Utah Consolidated Mines and O. N. Friendly, general manager. Several years ago, the Park City Utah Mines Company, controlled by the Lambourne interests, opened ore up in its upper levels in a winze sunk from the Star of Utah tunnel. Since that time, work was started from a heading leading off the Wasatch tunnel 500 ft. above. The new ore, carrying principal values in silver with some gold and lead, apparently is associated with the same fissure as the ore struck in the Star of Utah tunnel. Although somewhat erratic in persistence, geologic conditions are said to be favorable. A storage-battery locomotive has been installed on the Star of Utah tunnel, and work is to be resumed on the ore showing in this area.

▶ General Manager Gloyd M. Wiles of the Park City Consolidated Mines Company announces that the No. 2 shaft in the East Crescent fissure will be sunk an additional 400 ft. below the present 1,200-ft. level. In the Silver fissure, No. 401 winze is being deepened. Close to 150 men are employed at the mine. Ore production is averaging 150 tons daily.

▶ New development has been started at the New Park Mining Company's prop-

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▶UTAH

erty in the East Park City district, adjoining the Park City Utah mine, announces W. H. H. Cranmer, president. The Mayflower tunnel is to be extended a distance of 850 ft. to prospect the Park Galena fissure at a depth of 300 ft. below the orebodies in the Park Galena workings. A drift is also to be extended from the Mayflower tunnel to cut the Homestake fissure in the Homestake No. 2 claim recently leased from the Park City Utah Mines Company.

▶ The Tintic district's oldest mine—the Mammoth—paid a dividend of 5c. a share, or $20,000, on June 1.

▶ During the week ended May 15, the North Lily shipped twelve carloads of high-grade ore from the new development on the 1,300-ft. level in the southwest drift, 700 ft. from the shaft. All of this ore, it is reported, was taken from development work. Length of the shoot is said to be more than 100 ft. The ore, say reports, carries 1.5 oz. of gold to the ton, although some mine-car samples run as high as 25 oz. Drifting on the 1,350 and the 1,400 levels has been started. North Lily operations will show a handsome profit for May, it is reported, as result of the new strike.

ARIZONA

Development Planned for Cobalt Deposit

Bluebird group of claims, near Safford, taken under option and work will begin soon—Molybdenum Corporation expected to install first unit of a mill in the Twin Buttes district—Plant at Trench mine nears completion

▶ The Bluebird cobalt claims in the Turnbull district, near Safford, have been attracting attention of the mining world because of the mineral having virtually no production in the United States. There are 40 claims in the Bluebird group, which is now under option to Ralph L. Crothwaite, of Chicago, Ill. It is reported that under the terms of the lease and option, the lessee must immediately begin development and the construction of a 50-ton mill if such development warrants its construction. The consideration of the lease and option is reported to be $50,000, but the time of payments are not reported.

▶ Molybdenum Corporation of Arizona has taken over a group of 51 claims in the Twin Buttes district 27 miles southwest of Tucson. A small crew of men are at work on the property. The first 100-ton unit of a five-unit mill is expected to be installed at once. The property has been opened to a depth of 400 ft., with about 200 ft. of drifting at the lower level. It is stated the ore carries more than one per cent molybdenum. It is estimated that there are 50,000 tons of dump ore available for milling purposes. The company is capitalized at $1,000,000 and was organized by Major Terrill of Beverly Hills, Calif.; H. S. Hart, of 845 Riverside Drive, New York City; A. J. Simmons, Box 1248, Yuma, Ariz.; Ray A. Wheeler, 1614 North Park Ave., Tucson, Ariz.; and Matt McGee, representing McGee Brothers, also of Tucson. The offices of the company are in the Wilson Building, Wilshire Boulevard, Los Angeles, Calif.

▶ The old pumicite mine, near Bouse, and formerly owned by Joseph L. Cavanaugh, has been taken over by John E. Ahlborg, California Building, Denver, Colorado. A carload of the material was shipped to Denver for test purposes recently and steady shipments are now expected to go forward.

▶ American Smelting & Refining Company will soon complete a 200-ton mill to treat ore from the old Trench mine. B. R. Hatcher, of the Fenner Building, Tucson, is manager. About 150 men are employed at the mine under the direction of M. B. Lovelace, superintendent.

▶ Rocky Mountain Mines, Inc., has recently been formed by Lawrence B. Wright, of 1108 Federal Building, Toronto, Ontario, and associates are now operating the old Sheldon Superior mine under the new name. The property was a shipper for many years, and it is claimed to have a substantial tonnage of ore in reserve carrying gold and silver. A mill is proposed for early construction. The mine was purchased about a year ago from the First National Bank of Prescott.

▶ Tom Reed Gold mines, at Oatman, are installing a 12-ft. Dorr bowl classifier, trommels, settling tanks, and a pumping system whereby from 100 to 200 tons of tailings will be fed back into the mill from the dumps of the Ben Harrison tailings which were run during the early years of operation. Sufficient tonnage to keep the mill running for two to three years, even without its normal supply of crude ores from the mines now contributing to the mill supply, is reported. The company also reports the moving of its general offices from Pasadena, Calif., to the mine offices at Oatman.

▶ Five cars of copper-gold ore are being shipped weekly from the old Bullard mine, about 8 miles north of Agilla. The work is being directed by Ed. Husson. Thirty men are employed. The property is operating under a lease to the Bullard Gold Mines, Inc., Heard Building, Phoenix, Ariz.

Satisfactory progress is being made by the Phelps Dodge Corporation near Morenci, Ariz., in making preparation for mining the Clay orebody. Above are some of the first benches for open-cut mining.

▶ Tom Rogers and Dr. Purse are installing a five-stamp mill at Alamo Crossing on the Bill Williams River in southern Mohave County. Ore for the mill will be hauled from the Kimball mine about 5 miles distant. Both amalgamation and concentration will be used in treatment of the pulps.

▶ Rob Roy Development Company has taken over the King of Arizona mines, in Yuma County. Equipment has been installed and old workings are being opened. A. G. Simpkins, Box 711, Yuma, is manager of the company. Six men are employed.

▶ The 60-ton flotation plant on the Yarnell mine, in Yavapai County, is being enlarged and a cyanide plant being installed to work in conjunction, increasing the capacity to 100 tons daily. The present mill has been treating oxidized ores. Concentrates are shipped to El Paso, Tex. Mark Gemmill is general manager of the company and John McNeal is mill superintendent.

▶ Two miles north of Vicksburg, at the Desert mine, a new shaft is being sunk. Ore is being hauled to the mill at Harrisburg for treatment. The property is owned by Dr. C. D. Lesher, of Vicksburg. Work is under the direction of Clark Rhodehamel of Salome, Arizona.

▶ The New England mine in southern Mohave County, 60 miles south of Kingman, is shipping a carload of ore about every ten days. The values are in copper and gold and run from $15 to $20 per ton. It is planned to ship the ores to the Purse-Rogers mill, at Alamo Crossing, as soon as that mill is ready to operate. A. McFarlane, of Church and Franklin Sts., Tucson, is agent for the owners of the property.

▶ M. A. Hanna Company, of Cleveland, Ohio, are continuing diamond drilling of the manganese deposits in the Artillery Peak country in southern Mohave County. B. N. Weber, of 1211 East Willetta St., Phoenix, is in charge.

How to Get the Most Out of Your Rock Drills

I won't use bad shanks in my headings . . .

When I was running a drill, bad shanks caused me plenty of trouble. Sometimes they would be too soft and stick in the chuck. At other times, they would be too hard and chip. These chips usually ruined a drill by scoring the cylinder or spalling off the end of the piston. This meant a lot of lost hours.

I also used to get plenty sore when the man on the next drill finished up ahead of me just because my shanks were too long or too short and kept me from getting full drilling speed out of my machine.

Now that I am a shift boss, I naturally expect the best out of each of my men and I see that they get good steel so that they can do a good job. I don't want anything to hold up my headings and raise my costs so I just naturally won't have bad shanks at the face. When I find one, I sure get plenty tough. Wouldn't you?

• • •

Bad Shanks Delay You and Increase Your Drilling Costs

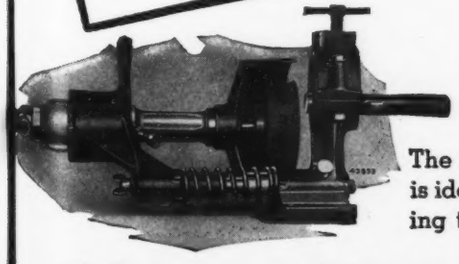
1. Soft shanks upset and stick in the drill.
2. Hard shanks spall the piston.
3. Hard shanks also chip and the small pieces of steel are apt to ruin the drill cylinder.
4. Short shanks cut down the drill's force of blow and reduce drilling speed.
5. Long shanks shorten the piston stroke and slow up drilling.
6. Round shanks, chipped shanks and shanks with too much bevel concentrate the force of blow at one spot on the piston. This breaks pistons. Shanks should be square.

Please Note

This is one of a series of talks intended to create a greater awareness of operating conditions, so that the users of rock drills can more nearly get out of their machines what the Ingersoll-Rand Company's designers, engineers, and metallurgists have built into them. Reprints of this talk or of any of the series may be obtained for your bulletin boards, for use as payroll stuffers, etc.

Spalled piston caused by hard or uneven shanks.

A perfect shank presents *a full* striking face to the piston.



The 4 K Shank Grinder is ideal for use in squaring the ends of shanks.

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SERVICE CENTERS and STOCKS the WORLD OVER

NEWS FROM Washington

By Special Correspondent

BUCK PASSING between the President and Congress is in the making. Congress took the steering wheel away from the Chief Executive last winter. But it seems to be asleep at the wheel, and the car is going round and round in the legislative back lot, getting nowhere fast. Well into the fifth month of the present session, Congress cannot point to a single item of important legislation enacted, except appropriations and a few new national-defense spending authorizations. Some measures which were to have been the principal business of the late winter and spring have not received any attention as yet.

To change this situation, conservatives believe, it will be necessary to have a large evidence of demand on the legislators from business men back home. "Little business" men are preferred. Big business has not yet escaped from the cloud of suspicion. But *any* business demands on legislators that they get busy and do something would help a lot. Life-long Democrats, some of them not normally overconservative, seem actually seeking to be pushed. It seems to be the old story of the Chinese laundry, "No tickee, no washee." Washington says, "No pushee, no billee."

Beryllium Brags

AS A NOVEL FEATURE in the TNEC proceedings, the Department of Justice brought up the question of beryllium and its alloys for a two-day hearing early in May. There was no statement made officially as to the purpose or expected "monopoly" significance. This resulted in much speculation as to both the purpose and the consequence.

One rather unexpected consequence was immediately evident. Spokesmen of various beryllium companies tooted their horns valiantly through this splendid monopoly megaphone. This light metal got more political and business notice about Washington as a result of the hearings than one could have bought with an indefinitely large advertising budget. It was all done very cleverly, but quite ethically too.

The story went something like this: Beryllium is a newly important element that can be used in many alloys. Some of these alloys have large military possibilities. Patents held in the United States and patents held by large German firms had to be pooled internationally in order that either party could go ahead most effectively on a commercial scale. This pool arrangement involved an agreement as to the partition of the world market between American and foreign enterprises. Strangely, little or no objection was made to this even by critics of business "deals."

The "human interest" angle on the situation came when beryllium nickel was mentioned. That commodity, it was claimed, has tremendous military and naval significance. It was so important that high British officials were said to have compelled modification of the German-American trade deal. They demanded, and got, the privilege of buying from America instead of from their potential enemy on the Continent. French interests maneuvered to secure their desired results. Altogether quite a Roman holiday of international dealings was presented, all about alloys still not commercial.

Below the surface of the beryllium hearing there was a real monopoly significance. Justice officials appear to feel that they proved that certain price collusion has existed. They emphasized this with respect to alloy users, not with respect to the mineral or "master alloy" producers. This seems to be the interpretation to be expected when TNEC findings are reported:

Vigorous effort has been made to find beryl both in the United States and abroad. Much research has been done on methods of processing this for metal recovery and in the making by patented procedures of the master alloy, beryllium-copper. The price of this alloy has been cut several times, usually by the second-rank company. Cuts from $30 a pound of Be contained to $15 a pound were reported. But, much to the horror of anti-monopolists, the prices of products made from this master alloy have been advanced. Simultaneous advances described "prove the collusion" among the makers of wire, so it is said.

Several important metal and mineral groups will be drawn into the official interpretations later. This is quite evident, though not officially stated. The mining industry can expect to hear much more about this newly important element and the evil ways of those who have dealt in products which include it. The two-day interesting show does not obscure the "monopoly" significance when one looks closely.

Waiting Time

CALCULATING HOURS worked under the Wage-Hour law is not always easy for employers whose workmen are required to report at some point other than the actual place of productive activity. This question has been one involving much discussion with respect to the employment of miners. The whole industry will, therefore, read with interest the Wage-Hour Interpretative Bulletin No. 13, issued in early May.

What appears to be the vital paragraph of that is:

"Many inquiries have been received with respect to period of inactivity due to the breakdown of machinery and time spent in waiting for materials to be furnished or waiting for the loading or unloading of railroad cars or other vehicles of transportation. Generally, the time during which an employee is inactive by reason of interruptions in his work beyond his control should be included in computing hours worked either if the imminence of the resumption of work requires the employee's presence at the place of employment *or* if the interval is too brief to be utilized effectively in the employee's own interest. This result would not be affected by the fact that the employer tells his employees that they are free to leave the premises. Hours worked are not limited to the time spent in active labor but include time given by the employee to the employer even though part of the time may be spent in idleness."

A few exceptions from this general rule are also outlined by Administrator Andrews, but in general the ruling means that an employee available to the employer is "working," no matter though he may be idle. The significance of this in the case of travel to a working place is also important, stated in the official interpretation, as follows:

"If a crew of workers is required to report for work at a designated place at a specified hour and all the employees are then driven to the place where they are to perform work, the time spent in riding to such place should be considered hours worked. Similarly, the time spent returning from the place at the close of the day's work should be considered hours worked. In some cases, however, the employer requests his employees to report for work at a specified hour at the place where the work is to be performed instead of at the employer's place of business. In these cases the employee's working time may be considered to begin at the time he reports for work, unless the traveling time required in order to reach the place where the productive work is to be performed is unreasonably disproportionate to the normal traveling time required in reporting for work at the headquarters of the employer. No precise formula will solve this type of situation. What is unreasonably disproportionate depends upon the facts in the particular case and reasonable standards agreed upon between the employer and employees will be accepted for purposes of the Act."

Also significant is the matter of voluntary activity of the employee briefly described in the following interpretation:

"Time spent in attending meetings and lectures sponsored by the employer (whether or not attendance is voluntary) should be considered time worked if such meetings and lectures are related to the employee's work, as, for example, meetings and lectures for the purpose of teaching the employee the use of new types of machinery on his job, mine rescue, fire prevention and control. In addition, time spent in attending any meetings and lectures should be considered hours worked if attendance is not wholly voluntary."

Tax Reforms

OBVIOUSLY the most important business legislation before Congress *might* be new tax legislation. The President would not choose to have any such bill this year. He has strongly intimated this privately; so it seems that even the more conservative fiscal leaders in the departments and in Congress have had difficulty in formulating a tax-relief program. During May, however, there was developed quite a force behind a very single group of changes of the law which seem likely of enactment if the conservative Democrats do not seek so much by their bill as to jeopardize it with veto possibilities. The four most likely items of the plan appear to be:

1. Complete elimination of undistributed profits tax, capital-stock tax, and excess-profits tax, with substitution of a flat-rate corporation income levy, which would not exceed 22 per cent on even the largest enterprises. Only the President's unchanged desire to retain undistributed profits tax seems to jeopardize this item. But even if enacted, this simplification plan will probably save little money for company taxpayers at the start. The main advantage will be simplification of returns and easier

Check Sheet for FLOTATION MACHINES

POINTS	DENVER "SUB-A" (Fahrenwald) FLOTATION MACHINE
MAINTENANCE	● **.0051 CENTS PER TON** is not an unusual figure for maintenance of a flotation cell when it's "Denver Sub-A." This figure is not determined after one month of operation . . . when the machine is new . . . but is a composite figure of many leading plants in different countries, and includes an average cost over an *operating period of five years.* A few representative plants have had the following life from *pressure-molded rubber* wearing parts. In several instances the parts are not as yet worn out, but many months of life and usefulness remain: Sunshine Mining Company . 1440 days McIntyre Porcupine Mines Ltd. 2130 days Falconbridge Nickel Mines Ltd. 1485 days Combined Metals Reduction Co. 1700 days Beattie Gold Mines Ltd. . . . 1457 days Northern Empire Mines Ltd. . 1631 days
METALLURGY	● ***EFFICIENT METALLURGY*** is a determining factor with every engineer and includes such questions as the following: How coarse a product can be circulated? (*Answer*) Material as coarse as ¼" can be circulated without choke-ups due to the exclusive *gravity flow* principle of circulating the material. What means used to control pulp level? (*Answer*) *Handwheel* weir gates give positive control of pulp level in each cell. How can you overcome surging in the cell? (*Answer*) New type receded disk impellers have completely eliminated all boiling action and give intense action and aeration in the agitating zone. What grade of concentrate can be made? (*Answer*) The highest grade concentrates and the lowest tailings are being made with the Denver "Sub-A" Cells due to their selective action.
HORSEPOWER	● ***FLEXIBILITY*** is the key to the question of horsepower when applied to flotation. So many misleading statements have been made about horsepower that even the most experienced flotation operator cannot be expected to know the answer. In a milling plant the horsepower of a flotation machine *must* include not only the power required to operate the machine but also the power for circulating and returning middling products (pumps or elevators) as well as the power for blowers when air under pressure is necessary. The Denver "Sub-A" requires no blowers, elevators, or pumps and the flexibility of the machine in circulating pulp *from cell to cell by gravity* accounts for the low power used. Horsepower per cell has been reduced to the lowest point for efficient agitation and aeration.
DEPENDABILITY	● ***THOUSANDS*** of Denver "Sub-A" (Fahrenwald) Flotation Cells . . . treating metallic and non-metallic ores . . . operating in large and small plants throughout the world . . . are your best guarantee of user satisfaction. As a leading mill superintendent recently told us, "It's not one advantage with your machine but the 101 small but important advantages which make the Denver 'Sub-A' so outstanding." The fact that a Denver "Sub-A" Flotation Machine can be started up and operated without attention . . . no valve twiddling being necessary . . . has accounted for the universal installation of these machines. Comparison of the advantages of this check sheet with any other flotation machine is invited. Today, Denver "Sub-A" is the "lowest cost flotation machine per ton of ore treated."

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determination of the tax significance when any company fiscal policy is under study.

2. Reduction in the high-bracket personal income rate from 75 per cent to 60 per cent is expected. Treasury experts are convinced that a lower percentage would increase the revenue.

3. Authorization of corporations to carry over losses for as much as three years in calculating income is planned. This, it is hoped, will smooth out peaks and valleys of Treasury income, as well as help business men.

4. The heart of the reform proposals is in "modification" of the capital-gains tax so as to encourage new venture capital. But the way to do this in a workable enforceable law has not yet been clearly defined even in the minds of the leaders who are very anxious to provide such releases.

In addition to these four income-tax features there will undoubtedly be a freezing of the Social Security levy at the present 1 per cent rate for another three-year period. There seems to remain no objection to that change. Many are even talking that Congress ought also to insist that many states lower the unemployment tax rates levied under another title of the Social Security law, for business relief. There is fair chance of that too.

Blocking Out Minerals

THE BUREAU OF MINES will undertake to block out mineral reserves for certain strategic materials when it gets the money provided by the strategic materials stockpile bill. As reported last month in *E.&M.J.*, this is regarded by Director Finch of the Bureau as being one of the major jobs which his Bureau should undertake with the $350,000 per year so to be provided. He, it appears, is going to leave most of the economic and resource studies to U.S. G.S., which also has an allotment of $150,000 per year under this same law.

But both institutions are just beginning to feel the political pressure. As one cynic says: "Every farmer who has found a 5c. piece on the hillside can prove to his Congressman that he has a potential nickel mine there." This is not much of an overstatement when one hears of the kind of proposals that are being brought in for survey and mines review. Just how these two department agencies will be able to select those supposed occurrences of minerals that do deserve thorough investigation has not been announced, and probably is not yet determined. It is known, however, that the Bureau of Mines will go out on some of the more promising strategic properties and actually do test hole digging or boring in order to block out orebodies in a preliminary fashion so persuasively as to permit dependable estimates of the reserve which is there. This takes substantial sums for each property studied. It is obvious that the number of field inquiries of this character will not be large.

A second type of inquiry planned by the Bureau is metallurgical investigation of new methods for processing of ores for which dependable technics are not now available. This type of investigation also takes substantial sums for each type of ore studied. It is fair to estimate that not more than a half dozen such inquiries can be going at once with the funds thus far allotted.

News "Fines"

Strategic Stockpile—House and Senate conferees are reported to have agreed on $100,000,000 for establishing "strategic" stockpiles over a four-year period. As a compromise to possible domestic producers, however, the clause which requires a bond by the vendor may be waived. The key men in the situation are the Secretaries of War and Navy, who may direct domestic production without requiring bond if they deem such production commercially feasible. Apparently the pressure-plea was that domestic producers couldn't afford the required bond. The question now to be answered is what and whether the domestic producers can afford to produce. The right of the President to find and declare the existence of a state of emergency with respect to any of these materials was stricken out of the original Thomas bill, and control of the stockpiles given to the Secretaries of War and Navy, as implied above, and the Secretary of the Interior. Provisions for barter, war-debt collection, and duty-free entry were also dropped from the bill when the conference committee adjourned.

Note, President Roosevelt signed bill S. 572, for the acquisition of Strategic and critical materials, on June 8.

Stream Pollution—The Barkley stream pollution bill was reported about the middle of May by the House Committee on Rivers and Harbors. A "state, municipality, or other public body" may receive a Federal grant-in-aid and/or a loan for the construction of necessary treatment works, but "persons" may not receive a grant-in-aid. A loan to an individual must be "fully and adequately secured and shall have interest at the rate of 5 per cent per annum; each loan may be made for a period not exceeding ten years." Such a loan would also "be made only upon the recommendation of the State health authority having jurisdiction and upon approval and recommendation of the Surgeon General."

Total Federal appropriation would be permitted up to $50,000,000 annually, and the Water Pollution Control Board would be amended to include an officer of the Corps of Engineers.

CIO Sun Setting—The waning of political strength by CIO was never more evident than when the President was forced to take a hand in demanding quick agreement that would renew coal mining promptly. This episode was probably far more significant than another of which the newspapers made much more—viz., the return of textile and automobile units to A.F. of L.

Adjournment—The President still wants Congress to go home. Congress does not care to leave the Chief Executive in full charge. Even those who have been forecasting adjournment in June now talk August.

Answer, or Else!—For TNEC an inquiry was addressed by the Department of Commerce to 2,300 trade associations in the form of a questionnaire. About 90 per cent replied fully. To the other 10 per cent the Department says, politely but pointedly, "In the case of those associations which are unwilling to cooperate, we will subpoena the appropriate officials to develop through oral testimony the information sought in our schedule."

Reorganization—The first two major plans for reorganization of the Government executive units have met with so general an acceptance as to insure full application without Congressional interference. Perhaps most surprising of these changes was the virtual abolition of the Bituminous Coal Commission by placing those functions in the hands of Secretary Ickes with the implied instruction to get rid of the troublesome unit as soon, and as quietly, as possible. Other Government units of interest to mining have not yet been touched, and certainly will not be until next year.

Labor Act Changes—Appointment of William M. Leiserson as chairman of National Labor Relations Board did much to remove the pressure for immediate reform of that body. Doubtless the hope of the President in naming this distinguished labor conciliator was just this. If no Congressional enactment of changes in NLRB law follows, as seems likely, there will be a good chance to find out whether it was the Act or the Smith regime in administration of the Act which caused the trouble before.

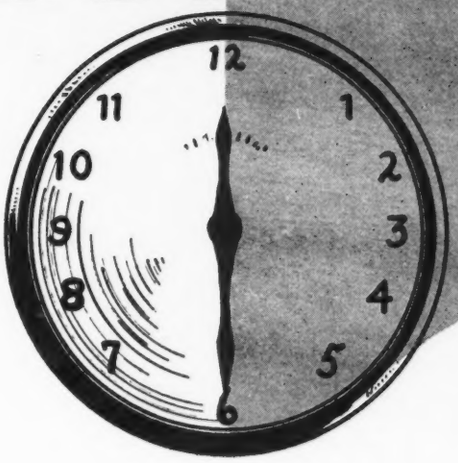
Putting Money to Work—Anyone with an important idea as to how to coax more venture capital out of hiding into industrial investment will be welcomed in Washington not only by conservative Democrats but also by the most radical New Dealers. The one subject on which every one now seems to agree is that no large curtailment of unemployment can occur unless more money for investment is actually put to work. The estimates are that it takes on the average $7,000 of new capital investment to establish a permanent job for one man.

Silver Prices—Silver-State Senators exhibit no anxiety as the date approaches when the price of domestic silver mined after June 30 must be announced. This is taken to mean, very logically, that the President and Congress have a plan fixed up whereby the bonus for domestically mined virgin silver will be paid regularly by Uncle Sam after June 30. But it is nothing like as clear that further silver purchases by the Treasury will be made abroad. The whole question of monetary legislation is likely to cause some additional tumult before June 30. Not surprisingly, few remain as advocates of the idea of continuing blanket silver purchases on the theory that this will help the mining industry. It has proved of help mainly to silver speculators, Washington thoroughly believes.

Money for Mineral Projects—Assigned by the President, the Interior Department appropriation bill carries principal geological and mineral projects as follows:

Geologic surveys throughout U. S.	$500,000
Mineral resources of Alaska	60,000
Mineral mining investigations	274,860
Oil and gas investigations	260,000
Economics of mineral industries	324,500

55-TONS IN 30 MINUTES!



WITH A #49 KENNEDY GEARLESS CRUSHER

Driven by a 75 HP motor and set to ½"

A TEST was run for one of the largest crushed stone companies in the United States on a #49 Low Head Kennedy Crusher they recently bought.

The time for crushing was measured to the second and the tonnage produced was accurately weighed. They found this crusher, which was driven by a 75 HP Synchronous Motor built in its pulley actually consumed less than 70 HP, and it gave them the remarkable capacity of 110 tons per hour. 85% of the material produced was minus ½" and was perfectly cubed from the initial flat product fed to the crusher.

There are a lot of reasons why the Kennedy, and ONLY the Kennedy Crusher can give such remarkable tonnages. With no rasping gears to limit the speed, this crusher can be driven at the highest number of eccentric turns per minute. Again, by using a Ball Bearing Gearless drive with no rigid eccentric, the Kennedy Crusher can produce far more tons per hour at less horsepower than geared crushers.

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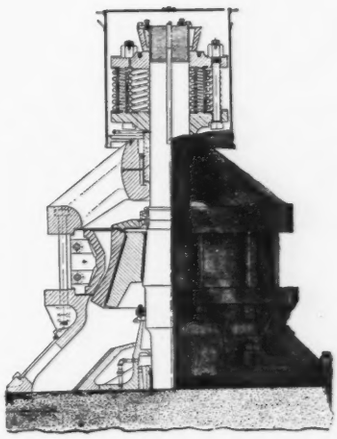
Why not send for a copy of our Bulletin #35 and learn more about the Kennedy Ball Bearing Gearless Crushers?



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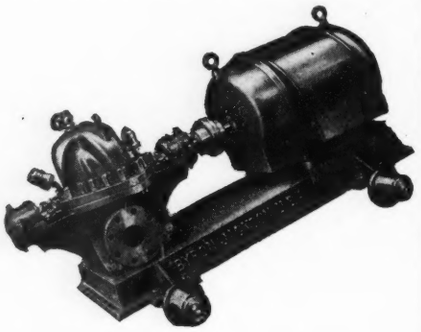
THIS PUMP OPERATES AT ANY ANGLE FROM HORIZONTAL TO 76 DEGREES

and gives you "dual duty" service at lowest cost



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MULTIPLEX PUMPS

are successfully used for dewatering mine shafts at any angle up to 76 degrees. Then, without alterations, it serves as a mine station pump or booster pump.

These pumps are compact in design, and the horizontal split case construction permits removal of the upper half of the casing (for inspection of the interior) without disturbing piping connections or pump alignment.

The pump pictured above is direct-connected to a splash-proof motor to form the unit generally used for incline service during dewatering operations and later as a station pump.

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MONTANA

Labor Unions Vote To Open Agreements

Members of C.I.O. and A.F. of L. seek changes in existing labor contract with Anaconda Copper Mining Company—Steward mines forced to suspend operations—Gold placer area along Missoula River to be tested

▶ On May 16 the Mine, Mill, and Smeltermen's Union at Great Falls and Anaconda and the other C.I.O. miners union at Butte voted to open the agreement with the Anaconda Copper Mining Company which expires Oct. 1. The agreement by the A.F. of L. which expires Sept. 29 was also voted by the craft members for new agreements. The company must be given 45 days' notice in the event the labor unions desire to negotiate for a change in existing labor agreements.

▶ The Steward mine of the Anaconda Copper Mining Company suspended operations late in May due to a dull copper market and a heavy accumulation of stocks.

▶ David Curry and sons, of Butte, are reported to have started milling ores at the Goldsmith mine, near Sheridan. They recently installed five stamps originally in service at the Kearsarge mine, near Virginia City.

▶ A new corporation known as the Western Gold Mines of Anaconda has been organized for the purpose of milling ores produced from the Southern Cross mine and other custom ores from the area in which that mine is situated. Capital stock of $50,000 of 1c. par is authorized. Incorporators are R. E. Thomas, J. R. Johnson, and C. M. Smith. A second corporation, the Southern Cross Mining & Milling Company, organized to carry on general mining business and capitalized for $50,000 in shares of 10c. value, was incorporated by R. E. Thomas, J. R. Johnson, and Ray Tower, of Anaconda, Mont.

▶ It is reported that plans have been completed for the testing of a gold placer area along a part of the Missoula River below Quartz Gulch. Mr. Heyfron, representing Portland and Klamath Falls interests, will direct the testing, which in part will be conducted from barges.

▶ According to reports, financial arrangements are being made by the Gold Ridge Exploration Company to begin a 900-ft. tunnel drive to develop a number of gold veins in the vicinity of the Royal Gold property in the Boulder district above Maxville. Claude Bielenberg is manager of the company.

▶ Taylor-Knapp Company has removed pumps from its deep-level work in the Two Percent mine in the Philipsburg district and plans to continue work for the present only in upper levels above the water level.

▶ At the regular meeting of the stockholders of the Anaconda Copper Mining Company recently held in Anaconda all officers were re-elected for the coming year. D. M. Kelly acted as chairman of the meeting. Directors renamed for three year terms are J. H. Perkins, J. R. Hobbins, and W. C. Potter—all of New York. The total number of stockholders of record was 107,917.

IDAHO

Bunker Hill & Sullivan Reports Large Orebody

Development so far completed indicates sufficient ore for ten years' operation—Diamond drilling reveals additional veins at the Ima tungsten mine—Idaho passes occupational disease law

▶ Bunker Hill & Sullivan, at Kellogg, recently discovered one of the greatest orebodies in its long history, according to President Stanly A. Easton. The oreshoot has now been exposed for 850 ft. in a continuous body, with the end not yet in sight. Tonnage of ore developed and ready for mining was reported as being 3,031,327 tons, or ample for ten years of mining. In 1938 Bunker Hill smelter at Kellogg sold 118,241,654 lb. of lead, 20,641,626 oz. of silver, 9,992 oz. of gold; and, in byproducts, 4,709,174 lb. of copper and 1,349,514 lb. of antimony. Quantities of metals sold during 1938 exceeded volume in 1937, but metal prices were lower.

▶ Diamond drills at the Ima Mines Corporation have disclosed four new veins paralleling the developed orebodies, according to President Ben R. Tillery, of May, Lemhi County. The modern flotation and magnetic separation mill is running 24 hours daily, turning out a high-grade tungsten concentrate. In addition to the tungsten the company is producing sulphide concentrates containing silver, lead, zinc, and copper.

▶ Idaho's new occupational disease law, better known as the "silicosis" law, is now in effect, with a medical board of six doctors set up to carry out instructions of the measure. Protection against the dust hazard is afforded in all major mines of the State. In view of the new law, the Sunshine mine has put an age limit of 60 years on underground workers or in unskilled surface work. Employees who have passed the age limit or who have an X-ray lung rating exceeding 2 plus have been discharged. Two weeks' wages at their regular rate beyond date of severance of employment were given the men laid off.

▶ The vein at the American Mining Company, Wallace, has shown a width of 14 ft. in a crosscut, according to W. E. Stache, of Wallace, secretary. A drift will be driven to a point beneath upper levels where gold and silver of good grade were mined.

▶ Annual reports of the producing mines of the Coeur d'Alene district show a marked reduction over the output of former years, reflecting the influence of

low metal prices. Net profits for 1938 totaled $7,024,223.88, compared with $13,007,556 for the previous year. Production was greatly reduced because of slow movement of lead and zinc from smelters where large stocks have accumulated. About half the normal number of miners were employed and only the larger mines continued operations. The Sunshine mine accounted for two-thirds of the district's net profits, reporting $4,881,058, a drop of $320,399 from the record for 1937, due to lower price of silver. Of the lead-zinc shippers, Hecla led with profits of $589,283 and Bunker Hill & Sullivan followed with $579,432. Federal Mining & Smelting Company reported a profit of $279,024 from the Morning mine, at Mullan, and the company's Page mine netted $195,956. Polaris, a new shipper, turned in a net profit of $385,951. The Crescent mine of the Bunker Hill operated at a net loss of $38,886. Tamarack & Custer lost $54,644, and Sherman Lead reported a net of $51,191.

▶ Liberal King, in the Pine Creek district, reports the drift on the 600 shaft level now in ore, the face carrying a full width from which assays 9.1 per cent lead, 3.6 silver, and 0.09 oz. gold were obtained. Manager Henry Weber, of Kellogg, reports two shifts employed.

▶ The Clayton Silver mine, in Central Idaho, is making a final survey covering additional water-power possibilities with a view of further expansion of mine output. The main working shaft will be deepened. Ore reserves were officially estimated as sufficient for two years at current mill capacity, in addition to 25,000 tons of ore broken in the stopes and ready for milling. Concentrates have been averaging $95.12 per ton in silver and lead. H. B. Kingsbury, of Wallace, is president, and C. A. Fay, of Clayton, manager.

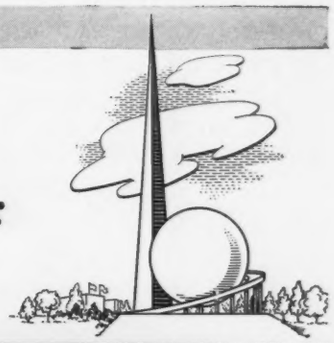
▶ Directors of the Hecla Mining Company have declared a dividend of 10c. per share, totaling $100,000, payable June 15. The present board was reelected, with James F. McCarthy, of Wallace, continuing as president-manager; L. E. Hanley, of Wallace, vice-president-treasurer; and A. W. Witherspoon, Clarence F. Kipp, George P. Mayer, Arthur J. Pellette, and Fred Searle, Jr., directors. Leo J. Hoban, of Wallace, is secretary and Bert Woolridge, assistant. President McCarthy reported the company had undertaken the development of the Simpson Gold mine, near Grand Forks, B. C.

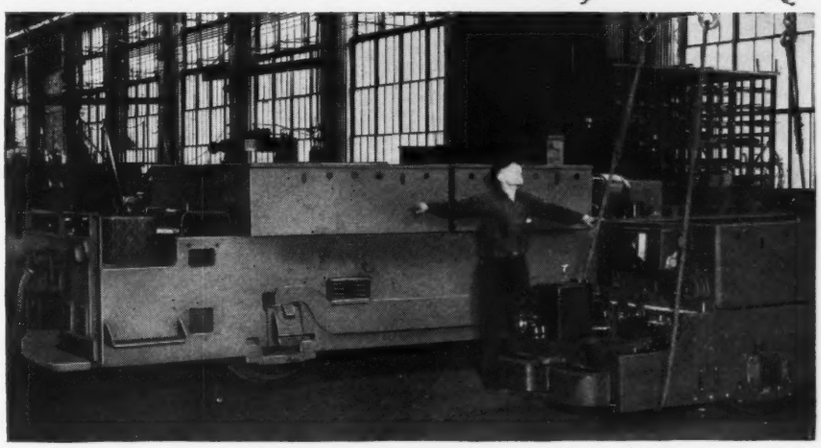
▶ The matter of changing the wage-hour law so as to exempt miners employed in isolated mining regions where the men would much prefer to work than remain idle around camp for two days of each week, has been the subject of much discussion among Idaho miners. The effect of the 40-hour week is costing miners of the Coeur d'Alene silver district approximately $100,000 per month in wages, or a total of more than $1,000,000 per year. Under the 6-day week, or 48 hours, this million dollars each year found its way into the pay checks of the 4,000 miners employed in this one district alone.

▶ The shaft of the Coeur d'Alene Mines Corporation has reached a depth of 2,328 ft. below the 1,000 level.

20 TONS

of Pulling Power for the World's Fair





The locomotive assembled, at our Erie, Pa. Works. At right is a 4-ton battery locomotive for mining duty

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DATA

Weight—20 tons
Drawbar pull—5600 pounds
Voltage—190 volts
Track gage—56½ inches
Wheelbase—96 inches
Length—240 inches inside knuckles
Height—63 inches
Width—92 inches
Control—drum-type with line breaker
Air brakes—straight and automatic

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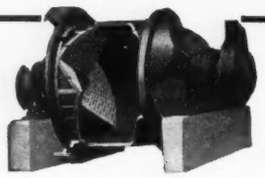

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This saving is due to the shape of the Williamson Mill which (1) grips the ball charge — prevents slippage (2) produces a mixing cascade which increases its grinding capacity.

The result: Less power, ball and liner consumption per ton of ore ground.

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At the Helena Mine, near Leadville, Colo., old mine dumps containing gold, silver, and lead ore are being removed by this diesel-tractor-mounted dragline shovel that averages 400 tons in eight hours

COLORADO

Matchless Mine to Have An Electric Furnace

First unit of 25 tons' daily capacity will be installed soon—International Smelting & Refining Company to rehabilitate two properties

▶ The Matchless Mining Company, operator of the famous Matchless mine, has entered into a contract with the Electric Mining & Supply Company, of Grand Junction, Colo., whereby the mining company will erect a 50-ton electric smelter at the Matchless mine. Thomas Palmer is president of the Matchless company and C. L. Klingaman is president of Electric Mining & Supply Company. This new electric smelter will cost about $50,000, and the first unit will have a capacity of 25 tons daily.

▶ The International Smelting & Refining Company, a subsidiary of the Anaconda Copper Mining Company, is preparing to reopen two of its properties, the Group and Lexington, on Newman hill. These mines, producers of ore containing lead, zinc, copper, silver, and gold, were formerly operated by the Palleyre Mining & Milling Company. Manager Stevens, of Salt Lake City, states that the company will retimber the two tunnels, complete the road to the mines, and install a new power line. Diamond drilling is also planned over the area.

▶ The Veta Mines, formerly the Smuggler Union, at Telluride, are regaining the prestige that once belonged to this rich district, and they are now constructing a 4,000-ft. flume to prevent pollution of the San Miguel River. The tailings will be carried in the flume to ponds created by retaining dams on its worked out ground on Gold Run placer. President Robert Sayre, of the Veta Mines, states that they produced in 1938, 800,000 oz. of silver, two-thirds of which came from the Ash Peak property and the remainder from the Veta Mines.

▶ The Durango district has made preparations for a big summer campaign. An action to quiet and confirm title to the vast holdings of the Gold King Mines Corporation, on Bonita Mountain, is indicative of the early resumption of mining and milling operations. Dr. B. J. Ochsner and associates expect to conclude negotiations for the transfer of the Durango Girl, reported to be worth $250,000. The three mines in the La Plata Mountains, 20 miles northwest of Durango, are not widely separated, and all carried on development work during the winter. Lessees of the Gold King, the Booker Brothers and Frank Spaeth, recently shipped high-grade ore to the smelter.

▶ Cripple Creek mining has kept up a steady pace, with the larger companies maintaining their schedules and others pushing development work. The new road to the proposed Carlton tunnel is progressing rapidly, and the Southern Colorado Power Company has completed a survey for a power line that will be completed in the summer.

▶ E. A. Ritter, consulting and mining geologist, who has spent many years in the Cripple Creek district, has completed the geological work for the Champion Mines Company, and on his recommendation the shaft is being sunk another 150 ft., expecting to cut the rich oreshoot that the Acacia Gold Mining Company worked in the Morning Star property.

▶ A new compressor has been installed at the Proper mine of the Allie Bell Mining Company, and the company is now producing a car of ore daily. The mine plant of the Gold King mine, in Poverty Gulch, has been completely modernized with electric equipment, and will soon be shipping ore. W. H. Webber, president of the Cameron Mines, Inc., has completed plans for tailings-disposal ponds and water reclamation; settling dams equipped with a decanting system

will be used, doing away with the thickners and thus permitting cleared water to be returned to the mill.

▶ Garfield Vanadium Company, at Rifle, under the direction of F. N. Nisley, of Fritvale, Colo., president, and Reuben Pitts, vice-president, reports it has developed a method of treating and concentrating vanadium ores. Known as the centrifugal bowl method, it involves feeding ore into a revolving screen-lined drum with jets of water forcing the ore across the screen. A. M. Wilson, engineer of Grand Junction, expects to start operations in July.

MICHIGAN

Hydro-electric Plant Will Be Completed

Dispute between subsidiary of Copper Range Company and State Conservation Department settled

▶ The Michigan Conservation Department and the Copper District Power Company, subsidiary of the Copper Range company, have effected a compromise in the Agate and Bond Falls dispute and as a result the power development above the falls will be completed. The dispute arose a year ago when the Conservation Department charged that the construction of a dam by the power company above the falls, on the middle branch of the Ontonagon River in Ontonagon County threatened the natural beauty of the falls and would menace fish life. The department asked the Attorney General of Michigan to obtain a court determination of the respective rights of the State and company, but the settlement recently reached will cut short the litigation. Under the terms of the agreement, the company agrees to maintain a minimum flow of 35 cu.ft. of water per second over the falls. In summer, however, when there are tourists to enjoy the sight, the rate will be increased to 90 cu.ft. This also will permit fish life to survive.

▶ Laboratory tests of rock samples from the lode in the White Pine property of the Copper Range company have been made to determine the best method of treatment, and results have been encouraging. The copper is fine and special treatment is necessary. The White Pine, in Ontonagon County, will not be reopened, however, until there is improvement in the copper metal market. When operations are resumed, the use of hydro-electric power will considerably lessen costs.

▶ The 250-ft. brick smokestack at South Hecla of the Calumet & Hecla Consolidated Copper Company at Calumet was dynamited and brought to the ground recently. One hundred pounds of dynamite were used. The stack, which had been damaged during a freak electric storm on Feb. 10, dropped perpendicularly, settling on its foundation. The inner shell of the stack was 17 in. thick and the outer shell 24 in.

20 M.P.H. TROLLEY HAULAGE

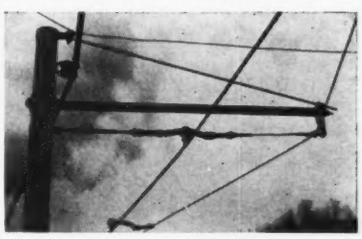
lowers operating costs for Willow Grove

Well-groomed Willow Grove's new O-B-equipped outside haulage is just as efficient in operation as it is attractive.

Model Hanna Property Capitalizes on Mechanization Program With Faster Haulage

Typical of Willow Grove's smooth running, modernized operation is this spick and span underground shop.

O-B Flexible Pole Brackets, Bulldog Clamps and Type N Curve Hangers maintain the wire at 20 m. p. h. efficiency.



A close-up of O-B Pole Bracket construction at Willow Grove.

Show place of alert Hanna Coal, Willow Grove knows well the economy of keeping coal continuously on the move from face to tipple. No haulage bottlenecks impair the efficiency of this completely modernized operation as loaded trips speed swiftly and surely to the tipple at 20 miles per hour.

Important adjuncts to Willow Grove's haulage efficiency are the O-B supported one-level trolley wire and the well-groomed high speed road bed. That O-B line materials were permitted to play such an important part in this all-important haulage system is a splendid testimonial to the ability of these products to do their job practically—economically.

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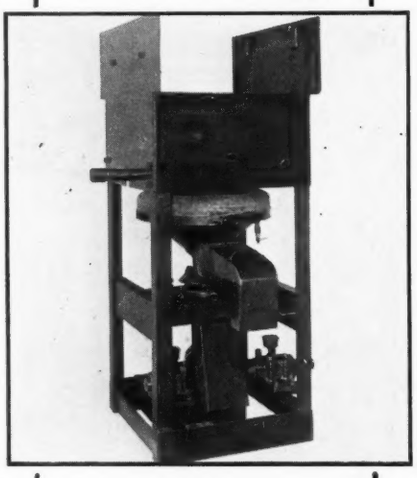

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TRI-STATE

Zinc Tariff Forces Smelter Shutdown

All operations of slab zinc division of the American Zinc, Lead & Smelting Company's plant at East St. Louis gradually being discontinued—Iron Mountain Lead & Zinc Company suspends operations at mine and mill

▶ On May 9 The American Zinc, Lead & Smelting Company notified the employees of its slab zinc division at East St. Louis, Ill., of its intention to discontinue all operation of retort furnaces at that plant for an indefinite period. This will necessitate the laying off of approximately 325 men, most of whom have been in the employ of the company for many years. It will be the first time this division has been entirely closed since it was built and put in production in 1914. In making this announcement it was explained that greatly increased operating costs brought about in the last three years through increased cost of labor, fuel, supplies, and taxes make it impossible to compete with the low price of metal coming into this country, under our new tariff rates, from Belgium and Mexico. The new duty which became effective Jan. 1, 1939, reduces the protection for domestic producers of slab zinc by $7 per ton. In addition to the reduction in duty, the ocean freight rate on metal has been reduced more than $3 per ton, making the total decrease in protection to the domestic producers of slab zinc above $10 per ton. The labor rates now being paid became effective when zinc was selling above 7c. per pound. Present rates represent an increase in common labor rates of 71 per cent and skilled rates of 38 per cent, or a plant average of approximately 44 per cent above the 1929 levels. In 1929 the average price of slab zinc was $130 per ton, which compares with the present price of $90 per ton, and there is little prospect in sight for a substantial increase in the world price of this metal.

▶ The Iron Mountain Lead & Zinc Company suspended operations at its mine and mill southwest of Baxter Springs, Kan., late in May because of the unprofitable concentrate prices. Approximately 40 men will be affected by the shutdown, according to W. H. Lewis, company manager.

▶ The Midwestern Mining Company has reconditioned the former Little Phoebe mill, east of Wentworth, Mo., and placed it in operation the latter part of April. Ore for the mill will be furnished by the Pflug Mining Company from its mine near Pioneer, about 16 miles south of the mill. The ore will be trucked from mine to mill. About 20 men will be employed at the mine and mill.

▶ The Davis-Big Chief Mining Company placed the Kropp mine and mill, which it recently purchased from the Indian Mining & Royalty Company, in operation the middle of May. The mill has a capacity of 40 tons per hour. Approximately 50 men were employed, according to C. E. Niday, manager for the company.

▶ Beck Mining & Royalty Company took over the operation of the Beck No. 1 mill the latter part of May after the Eagle-Picher Mining & Smelting Company had turned back the lease on the mill. The mill will be operated as a custom mill under the management of C. W. Nicolson.

▶ With the completion of the necessary changes to divert ore from the Humbah-wah-tah, See Sah, and Blue Goose mines to the Central mill, Eagle-Picher Mining & Smelting started work on a 3,000-ft. spur from the north boundary of the Bendelari lease to the Wilbur mine near Treece, Kan. This spur was completed late in May, and ore from the Wilbur and Chubb mines, which are connected underground, will be sent to the Central mill after the first of June. This will leave only the Bird Dog and Webber mills of the group that were acquired from the Commerce Mining & Royalty Company last December.

BRITISH RAISE ZINC DUTY TO £1 10s. PER TON

EFFECTIVE MAY 26, the British import duty on non-Empire zinc was raised from 12s. 6d. per ton or 10 per cent advalorem, whichever is less, to £1 10s. per ton. The change was made on recommendations by the Import Duties Advisory Committee after weighing the needs of the British zinc industry for about seven months. The British authorities hope to stimulate home production of slab zinc by raising the duty on foreign metal.

Imports of slab zinc into the United Kingdom during the first four months of 1938 and 1939, in long tons, were as follows:

From:	— Jan.–April — 1938	1939
Australia	5,298	4,820
Canada	31,547	31,574
Northern Rhodesia	513	2,583
Germany	893	1,788
Belgium	17,673	18,400
Other countries	4,500	4,361
Totals	60,424	63,526

According to London advices, the decision to raise the duty was made with the understanding that Empire producers will try to re-establish the Zinc Cartel and stabilize the price between £14 and £16 per ton.

▶ On June 1, announcement was made by officials of the United Zinc Smelting Corporation that the company's plant in Moundsville, W. Va., would be closed indefinitely. Mr. Lohman, president and general manager, gave no explanation for the shutdown. At the time the company announced a 10 per cent general wage reduction in May, Mr. Lohman said the reciprocal trade policy of the Administration was permitting importation of large quantities of foreign zinc into this country.

▶ Clinton H. Crane, president St. Joseph Lead Company, recently presented a 50-year service gold medal to Louis La Chance, who has been in the employ of the company continuously for that time. The Schaeffer Medal, awarded by the National Safety Council, was presented to Goldman Burns, an employee of the company, who saved the life of a fellow worker, Henry Beck, from electrocution. Mr. Crane spoke in Flat River, Mo., on May 12 and pointed out that the company started in Bonne Terre 75 years ago this year. He said, "Our policy has been and is to give regular work so as to make it possible for men and women to raise their families here with confidence in the future. The fact that the Bonne Terre mine has been operated now for 75 years and is still operating, and that our engineers do not see an end, gives me best hope that the district still has a very, very long life. It is also my confidence that, if we work together as we have in the past, we will still be able to compete with other districts in supplying the lead the United States needs."

IRON COUNTRY

Shipping Season Begins On Restricted Basis

Preparations for summer operations get slowly under way—Oglebay, Norton & Company may increase holdings

▶ Consumption of Lake Superior iron ores during April totaled 2,799,769 tons, compared with 3,316,619 tons in March, and 1,853,658 tons in April, 1938, the Lake Superior Iron Ore Association reports. Reduced consumption reflected the decline in number of blast furnaces in operation, which dropped from 97 at the end of March to 80 on the last day of April. This compared with 64 out of 188 in blast April 31, 1938. Iron ore on hand at furnaces and Lake Erie docks on May 1 totaled 22,790,933 tons, compared with 25,872,124 tons a month ago and 33,676,333 tons a year ago.

▶ Important news to the Range people was an announcement by Oglebay, Norton & Company that the company may possibly take over the Mesaba Iron Company's interests at the east end of the Mesaba Range where the magnetic lean orebody of the Mesaba Iron Company is located and where the company built a large crushing and sintering plant some time ago. The present plant has been idle since 1924 and was at that time producing about 600 tons of sintered ore per day.

▶ The Mahoning Mine, Hibbing, Minn., operated by Pickands-Mather & Company, started shipping recently, and the Oliver Iron Mining Company's mines were all started on a regular schedule during the middle of May. Most of the other independent mining companies are shipping on a restricted basis, but it is expected that this will be increased if stability develops in the steel industry.

▶ Oliver Iron Mining Company has purchased a new 120 B Bucyrus electric shovel for the Arcturus iron mine at Marble, Minn.

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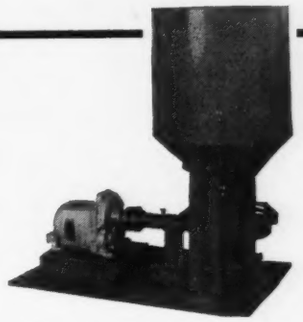

Compact, simple construction, easily regulated and built of first class materials, this Southwestern Dry Reagent Feeder is designed to give long, satisfactory service with dependable uniform accuracy. Write for detailed information.

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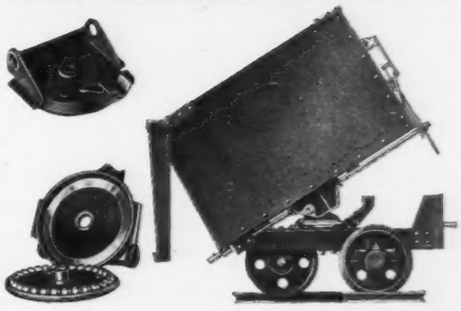
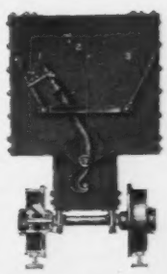
The body of this balanced type, all-around dump mine car revolves on a ball-bearing turntable and may be dumped on either side or over the end as shown. Single dump control lever and door lock are conveniently located at end of body as illustrated. Write for descriptive Bulletin on the Koppel line of cars.





Easy turning under load is assured by ball-bearing turntable. Note 3 positions of control lever. In first position body and door are locked—second, body unlocked permitting turning to dumping position. Third, body and door *both* unlocked for dumping.

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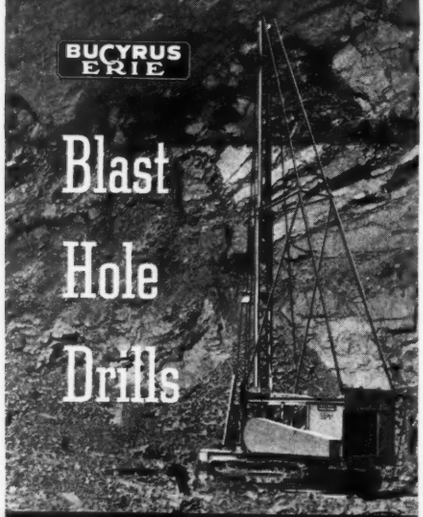

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MEXICO

Miners' Cooperatives Desire Autonomy

Members tell Ministry of National Economy they are not interested in having politicians conduct their affairs—Mineral production in Republic increased in 1938

▶ The end of spring found Mexican mining reflecting much of the general condition of the country, uncertainty and a deepening of the acute economic depression. The national miners' union was obliged to open on June 1 instead of June 19, the date originally set, its special convention in Mexico City, owing to numerous difficulties that beset the industry. There is a marked trend of mining cooperative societies for autonomy in the running of their business and the divorcing of their affairs from politics. Production in 1938 was on a whole greater than that in 1937. Several labor conflicts were settled.

▶ Politics and cooperative mining do not mix, cooperative miners of Hidalgo and Zacatecas told the Ministry of National Economy in answering its request for views of these miners concerning proposed amendments to the law that regulates these organizations. These miners ask that mining cooperative societies be allowed autonomy in the conduct of their internal affairs, that there only be government intervention when such action is required by law and that the societies be prevented from being "the instrument of professional politicians." The Zacatecas and Hidalgo miners told the ministry that it has been demonstrated that when politics enter the mining cooperative scheme, discord is always the result.

▶ An agreement for the recovery of antimony from its Pacheco mine, Nieves, Zacatecas, on a 15 per cent royalty basis has been made by the Cia. Minera y Refinadora Mexicana, S.A., Lic. Ramon Arbide, counsel, with 30 of its organized miners. The pact was approved by the Federal Labor Department.

▶ Production, excepting silver, copper, and some of the minor metals, was much higher last year than in 1937. It is shown by the following figures of the Ministry of National Economy, the amounts being in kilograms:

Product	1938	1937
Gold	28,734	26,326
Silver	2,519,967	2,633,870
Copper	41,851,049	46,077,254
Lead	282,368,713	218,133,072
Zinc	172,217,721	154,624,700
Antimony	8,033,885	10,638,982
Graphite	9,610,699	11,209,537
Mercury	293,683	170,157
Arsenic	8,894,440	10,762,423
Molybdenum	805,776	1,049,315
Bismuth	185,797	141,684
Cadmium	762,398	619,792
Tin	253,458	379,480
Tungsten	70,488	30,680
Vanadium	180,043	44,728
Manganese	117,476	17,214
Cobalt	861	.....

Exports in December, 1938, the most recent month for which official data are available, were, amounts in kilograms: **GOLD:** 2,678—United States, 2,654; Germany, 14; Belgium, 7; France, 3; **SILVER,** 150,407—United States, 143,982; Germany, 2,999; France, 2,075; Belgium, 1,334; England, 17; **COPPER:** 3,871,557—United States, 3,786,860; Belgium, 59,500; France, 25,197; **LEAD:** 20,771,849—United States, 10,959,516; England, 3,700,756; Germany, 2,172,194; Denmark, 1,330,900; Sweden, 697,055; Norway, 544,990, Holland, 486,258; Finland, 392,895; Belgium, 282,830; Czechoslovakia, 152,125; France, 26,981; Brazil, 25,349; **ZINC:** 9,055,231—Belgium, 3,674,134; Germany, 2,449,388, France, 1,558,463, Japan, 623,175; United States, 396,910; British India, 353,161;

▶ The cooperative society running the La Pompeya mine, near Ciudad del Catalan, Guerrero, suffered severely recently at the hands of a mob of armed men who raided the property to the shouts of "Death to officials" thrashed several miners and their wives, burned the society's books and other records, and fled with 3,500 kg. of ore, mostly gold-silver.

▶ The federal labor department has advised mining cooperative societies to settle their disputes in accordance with the law of such societies rather than by precepts of labor unionism. The department asserted that miners who join cooperative societies automatically resign from mining unions.

▶ Mine lands concessionaires must be afforded ample opportunity to pay taxes on their property and given sufficient warning that they are in danger of such action before their franchises can be cancelled, the Federal Supreme Court ruled recently in upsetting a cancellation order of the Ministry of Finance in the case of Jose Lopez G., concessionaire of the El Perdon opal mine, Cadereyta, Guerrero.

▶ An important sea outlet for central Baja California mines is being provided by the Federal Government with the start of establishment of a deep-sea and coastwise port at Punta Peñasco at the head of the Gulf of California, which is southern terminal of the railway the government is building from Fuentes Brotantes. This port work, which will cost 5,000,000 pesos (about $1,000,000), is to be completed by Dec. 31, 1940.

▶ President Lazaro Cardenas has instructed the Federal Department of Health to investigate the petition of the Confederation of Veterans of the Mexican Revolution that seeks government assistance for the 270 unemployed miners in Sonora said to be suffering from silicosis. The Confederation states they contracted this disease while working for Cananea Consolidated Copper, Cananea, Sonora.

▶ A convention to discuss a new work contract has been called by the Federal Labor Department for Mazatlan, Sinaloa, of representatives of Mexican Candelaria, Contra Estaca, Sinaloa, and Talyotita, Durango, and the company's employees.

▶ A ruling of the national supreme court that directly affects the mining industry, rendered in the granting of an injunction to the Cia. Minera Santa Maria y Anexas, S.A., Matehuala, San

Luis Potosi, against the order of the Ministry of Agriculture that it must build houses for its employees, has inspired much favorable comment. The court held that industrial companies in Mexico have no obligation to provide dwellings for their workers, and ruled that provision of these accommodations is entirely optional for the companies.

▶ Intervention of the Federal Labor Department settled a queer work conflict for Mazapil Copper, Concepcion del Oro, Zacatecas. The trouble resulted from the company's dismissal of an employee. That provoked the national miners' union and brought a threat of a strike.

SPAIN

Gold in Iron Gossan Recovered at Rio Tinto

Cyanide and charcoal process is employed in concentrating low-grade gold ore found in an iron capping—Ministry of Industry organizes metal industry

▶ Rio Tinto's Spanish mines, Sir Auckland Geddes, the chairman, said at the annual meeting, were worked continuously last year, and shipments of ores came to 1,282,972 tons, against 1,424,998 tons the preceding year. Payment has continued to be made in pesetas of at present unknown value. The company has 36,275,071 of these pesetas, and its deliveries of goods, ore, and sterling to the Spanish Government have amounted to over £2,850,000. Now that the civil war has ended, the outlook for the future of the mines in Spain is considered to be more hopeful, despite the export of pyrites to France having been prohibited. Income from its large investment in Rhokana Corporation shares has enabled Rio Tinto to continue paying the dividends on its preference stock. "A new feature of our operations (in Spain)", Sir Auckland said, "has been the recovery of gold in the form of a concentrate from the ferruginous gossans forming the capping of one of our lodes. As a result of experimental work carried on for some time in conjunction with Minerals Separation, Ltd., a novel process has been perfected utilizing cyanide as the solvent and activated charcoal as the precipitant of the gold, which is recovered by flotation. We have thus been able to deal satisfactorily with a very low grade gold ore and to put into service our concentrator, which was built to treat cuprous ores, but which had been idle since 1932."

▶ The Ministry of Industry of Spain is organizing the lead industry by bringing producers, manufacturers, and traders together in a single group. Production of lead in Spain is expected to increase this year. A large share of Spain's surplus production will probably move into Germany and Italy, observers here believe. The Ministry also issued a decree early in May that provides for taking over stocks of copper and regulating the industry.

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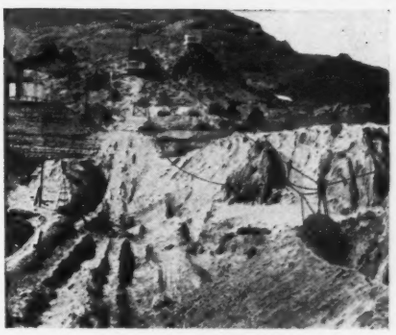

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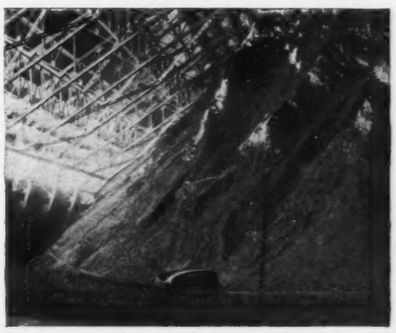

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CANADA

Montclerg Property Near Porcupine to Be Explored

Newmont Mining Corporation and Anglo-Huronian Mines interested in undertaking —Decision expected soon on Augite mill construction—Sheep Creek Gold Mines increase holdings

▶ Montclerg Mines now has the financial backing of Newmont Mining Corporation and Anglo-Huronian Mines for making a large-scale exploration of the Monteith property, 25 miles east of Porcupine. The program will be in charge of M. F. Fairlie, consulting engineer, basing plans on the results of diamond drilling that showed gold values distributed over an exceptionally wide zone for a length of 2,200 ft. The original discovery was made at a small, isolated outcrop in an area of farm land and muskeg. Hollinger, Consolidated Smelters, and other mining companies have acquired control of much of the ground lying between Monteith and the Pamour mine for the purpose of drilling the large concealed interval in search of a possible eastward extension of Porcupine ore-bearing structures. President of Montclerg Mines is D. M. Hogarth; Joseph Errington is vice-president.

▶ Shaft sinking at the Augite mine has reached a depth of 1,000 ft. and a continuous ore zone has been indicated from Delnite Porcupine, on the west, to Buffalo Ankerite, on the east. S. S. Saxton is mine manager. The adjoining claims held by Noranda Mines have been merged with Augite, which has been reorganized as Aunor Gold Mines, financed by Noranda for extensive development work and mill construction. Late in May the property was visited by Oliver Hall, James Y. Murdock, and Dr. W. F. James, who are completing plans for a program that is expected to lead to a decision by next August for a 500-ton mill.

▶ Encouraging results are reported from Elmos Gold Mines, in the Little Long Lac area, where Newmont Mining Corporation is in charge of operations. The main vein has been opened up at a depth of 515 ft., the new bottom level. At the 315-ft. horizon ore has been developed in the main vein for an aggregate length of 384 ft., the cut grade averaging $17.50 a ton across 21 in. Newmont has agreed to provide $72,000 for continuing underground exploration to determine whether the property can be brought into production.

Quebec

▶ Amm Gold Mines, in the Cadillac district, is Quebec's newest gold producer. In April the mill treated an average of 144 tons daily, and mill heads are running about $7 a ton. Tailings loss is stated to be 31c. per ton, with working costs at $3.65. The 150-ton mill, built by Paddy Fleming, of Hailyburg, is giving excellent results.

▶ Diamond drilling for depth exploration has been started at the Belleterre mine, at Mud Lake, in a search for parallel ore conditions in the main No. 12 vein below the 375-ft. level. The vein has been traced on surface for 2,900 ft. and $11 ore has been established over 5-ft. widths for a length of 1,650 ft. Widths and values have been confirmed by 900 ft. of drifting on the first and second levels. Just above the third level the vein fracture passed from andesite into basalt, where the gold content disappeared. Ore reserves at March 31 were estimated at 238,323 tons —sufficient for more than three years' operation of the 200-ton mill. Cash advances from McIntyre Porcupine Mines total $360,000. Bullion recovery during the first nine months of operation was valued at $372,813.

Manitoba

▶ A new oreshoot has been opened up for 100 ft. at God's Lake Gold Mines, on the sublevel between the fourth and sixth levels. The ore grade of $22.40 across 4.3 ft. represents the richest section so far encountered in the mine. The oreshoot is estimated at 20,000 tons, with another 60 ft. to be tested before the fault zone is reached.

▶ Beresford Lake Mines has arranged financing for a development program. After dewatering the Solo shaft, a raise from the 375 level will explore a diamond-drill intersection 30 ft. above. J. D. Shannon, who formerly worked the property under lease, continues in charge of operations.

▶ Athona Mines has been negotiating with Consolidated Smelters for milling Athona ore on a basis of 100 tons a day from the H vein. A winze on this vein disclosed 30 ft. averaging $20 per ton over vein width and an additional 40 ft. of lower grade. The winze is to be deepened to 375 ft. and a new level developed. Crosscutting to the M vein is in progress, and the K and L veins are to be investigated this summer.

British Columbia

▶ Sheep Creek Gold Mines, Ltd., leading producer in the Salmo area south of Nelson, has added to its potential life by the acquisition of the Ore Hill group of twenty claims adjoining the main property to the south. R. W. Bruhn, president, states that a crosscut will be driven for a distance of 1,600 ft. to the Ore Hill ground.

▶ The financial position of Pioneer Gold Mines, Bridge River, was improved substantially in 1938, and the company engaged in an aggressive search for new properties, although as yet without conclusive results. Dr. H. T. James, is managing director.

▶ Excellent results are being obtained in opening the vein system at the Bralorne mine, Bridge River, in the new levels from the 11th to the 14th, according to Richard Bosustow, managing director.

▶ D. S. Tait, president of Privateer Mine, Ltd., Zeballos, states that work is being started to open at depth a new vein, the P.4.A., recently exposed on the surface for a distance of 250 ft. Channel samples taken in six open cuts averaged 8.49 oz. gold per ton across

an average width of 6 in. The orebody in the main vein has now been opened at the 1,100 level for a length of 791 ft., averaging 0.47 oz. across 14 in.

▶ Ore has been developed rapidly at the Havilah mine, near Port Alberni, and whereas it was intended to build a 25-ton mill, it is now proposed that a 100-ton plant be erected. It is stated that one oreshoot has been opened for its full length of 470 ft. at Nos. 1 and 2 levels, averaging approximately 0.5 oz. across 2 ft., and another oreshoot has been developed for a length of 250 ft. to date at No. 3 level.

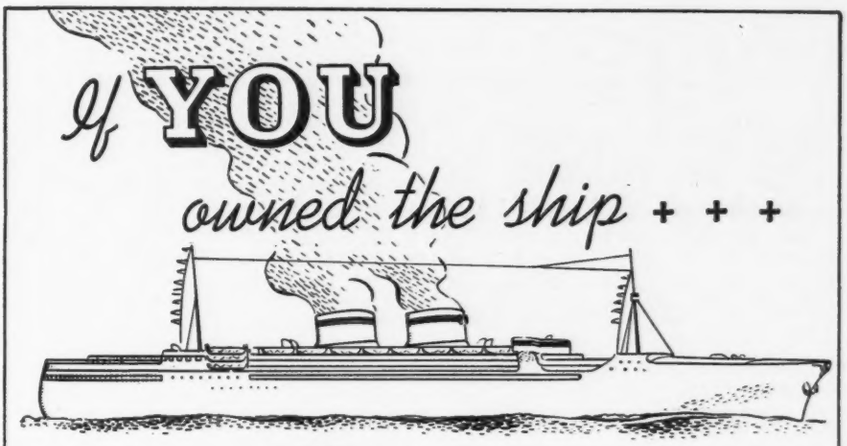
▶ Lode mining in the Cariboo is progressing satisfactorily. Extensive development programs are being conducted at both the Cariboo Gold Quartz and Island Mountain mines near Wells.

▶ Operations at the Big Missouri mine, near Stewart, have been curtailed for a few weeks due to a shortage of water power. The capacity of the underground mill has been increased from 622 tons a day to between 700 and 750 tons by the installation of additional screens in the crushing section. A profit is being earned despite the low grade of the ore, which averages 0.09 oz. gold, as operating costs have been reduced to the low figure of $2.04 per ton.

▶ Title to the old Blewett mining claims in southern Chelan County, Wash., was finally settled in possession of J. B. Woodworth, mining engineer of Vancouver, B. C., by a decision of Superior Judge W. O. Parr, following a five day trial. The property has been in litigation from time to time for the past 30 years. The old Blewett mine was a large producer 40 years ago, keeping from ten to twenty stamps in operation on high-grade ore for many years.

Yugoslavia

▶ Trepca Mines, Ltd., reports a net profit of £42,323 for the March quarter. This is after an allowance of £20,750 for depreciation and Yugoslav taxation, and thus is subject only to British taxation. It compares with £47,732 for the December quarter, when the price of lead averaged £1 5s. 8d. and of zinc 14s. 10d. higher. Working costs were slightly lower, 19s. 4d. per ton of ore treated, against £1 0s. 5d. On the 435-meter level of the Stanting mine, the development of which was started last year, a further area of 629 square meters of ore was put in sight. This addition raised the average in lead, zinc, and silver of the total of 5,758 square meters so far developed on this level, indicating that the richer portion of the ore is only now beginning to be attacked. The possibilities of this the 435 level are of great interest, as on the level above, the 485 meter, the area of ore horizontally is 8,939 square meters, the largest so far developed on any one horizon in the mine. So far the ore has been found slightly richer in lead and silver on the 435 level than on the 485. The percentage of zinc is continuing to decrease with depth, being only 1.67 per cent on the lowest level, against 8.72 per cent lead and 6.31 oz. (the highest yet) of silver per ton.



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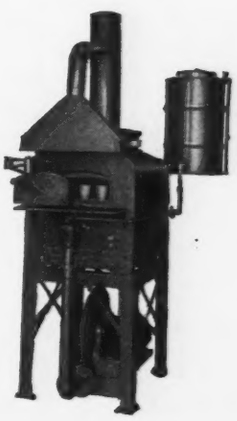

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AFRICA

Rich Strike Reported in Orange Free State

Recent drilling results show high gold content over 6 ft. wide, in a reef more than 100 miles beyond presents limits of the Rand—Gold discovery made near Uganda and Kenya border

▶ Western Holdings, continuing to drill its vast area in the Orange Free State, has made what may prove the most important strike of this generation in its relation to the future of South African gold. The reason it may be so important is that two previous holes had passed through conglomerates of a character suggestive of the upper Witwatersrand series. These contained some values in gold, but evidently were considered by the engineers to yield greater value in information. It was apparently assumed that the strike of the formation was north and south, and that to cut the Main Reef, or bottom, series it would be necessary to drill farther east. A new borehole, No. 7, was at any rate started at a point nearly a mile east of No. 1, and it is in No. 7 that the latest strike has been made. After cutting interesting belts of conglomerate and quartzite at a depth of 1,086 ft., one of which showed 10.4 dwt. over 13 in., it penetrated at a depth of 1,143 ft. a conglomerate which assayed an average of 35.2 dwt. over a width of 52.4 in. This with 8 in. of 3.6-dwt. conglomerate and 14 in. of 0.8-dwt. quartzite immediately above, makes over 6 ft. that averages 25.44 dwt. per ton. If this is the Main Reef it will prove its extension for some 100 or 150 miles beyond the limits of the district in which it is now yielding approximately half the world's gold production. Western Holdings has later reported the result of second sample of the formation recently penetrated in its No. 7 borehole. By deflecting the hole the beds were cut again, but how far from the first cutting is not stated. This second test shows, at a depth of 1,089 ft., 26 in. of conglomerate averaging 7.9 dwt., and then, at 1,147 ft., 60½ in. of conglomerate reef averaging 45.9 dwt. It will be noted that the second is better than the first, and that both show sensational values over exceptional widths for the district. But what is of particular interest is that this discovery proves the Witwatersrand reefs still richly mineralized at a point 150 miles southwest from Johannesburg.

▶ The Borderland Syndicate, registered in Kenya Colony, is reported to have made important discoveries of gold on the border of Uganda and Kenya. A shaft is down 170 ft. Drive south from bottom shows, from 25 ft. to 70 ft., 44 dwt. over 10 in. average width, and for 80 ft. north 26 dwt. over 20 in. Excavating another occurrence, 415 tons is said to have yielded 325 oz. Borderland Syndicate is controlled by Tanami Gold Mining Syndicate, and London Australian, General Exploration and Leonora Corporation are said to be interested.

▶ The Geita mine, in the Kentan Gold Areas concession immediately south of Lake Victoria, in Tanganyika Territory, is by now in full production. Its mill was started in January, and during the first four months, to April 30, it recovered 5,246 oz. of gold from the treatment of 21,173 tons milled. More recently a ropeway has been completed, which is enabling ore from a richer mine to be received at the mill.

▶ Rosterman Gold Mines, operating in Kenya Colony, reports that driving from the 9th level of its shaft, which is down 898 ft., has revealed for a distance of 90 ft. average values of 66 dwt. over a width of 53 in.

▶ Luiri Gold Areas resuming milling treated 2,995 tons of ore in April and recovered 412 oz. of gold. This ore is said to have come from the low-grade stopes, extraction of the richer ore awaiting installation of further equipment.

AUSTRALIA

Wiluna Gold Mines, Ltd., Continues Exploration

Diamond drilling below present workings reveals little ore—Norseman Gold Mines, N.L., resumes production from the Iron King Mine—Wellington Alluvials runs into dredging ground

Western Australia

▶ During the quarter ended March 31, Wiluna Gold Mines, Ltd., treated 146,067 short tons for a yield of 23,495 oz., or 3.2 dwt. per ton. Working costs, excluding development and exploration, were 22/– Aust. per ton, leaving a surplus of £A54,632, of which £35,747 was expended on development and exploration, and £8,937 on construction and equipment. Recent development results in the main mine continue to be disappointing, diamond drilling at depth below the present workings having disclosed nothing of economic importance, and in the Bulletin section results at the 1,200- and 1,400-ft. levels have not confirmed the prospects indicated by diamond drilling. In the Happy Jack section development is as yet insufficiently advanced to appraise results. Meanwhile, a horizontal borehole 90 ft. east of the Happy Jack shaft has intersected ore 23 ft. wide at a depth of 600 ft., average assay being 5.7 dwt. The new controlled temperature roasting process is proving successful; although recoveries are somewhat less than by smelting, the lower cost more than outweighs the increased losses, resulting in a greater over-all profit.

▶ Norseman Gold Mines, N.L., recommenced regular production from the low-grade Iron King Mine on April 6; announced plans are for an output of 5,000 short tons monthly from this source.

Victoria

▶ Central Nell Gwynne, the principal mine on the Bendigo field, showed a marked drop in profit, to £A4,735, for the half year to March 31. This was caused by the poor grade of ore treated during the period, 11,661 tons crushed yielding 2,086 oz., or 3.6 dwt. per ton, plus concentrates valued at £1,044, total revenue being £19,084. Costs totaled £4,348, or 24/7 per ton.

▶ Operation of the new ten-head battery of Chewton Gold Mines, N.L., Chewton, is now proceeding satisfactorily after the usual initial adjustments. The management estimates that there is from five to six years' ore, averaging 8 dwt. per ton, showing in the mine, but it is not intended to increase the size of the battery until further development work is done.

New South Wales

▶ Wellington Alluvials, Ltd., Wellington, has commenced to replace its bucket band and expects to suspend operations for a short period to enable completion of the job. It was reported earlier in the year that trouble was being experienced owing to failure of the buckets and that replacement would be necessary, the ground proving to be harder than expected.

▶ Kikoira Tin Mining Syndicate has been formed to develop leases on the newly discovered alluvial tin area in this district. A wide field of wash is reported to have been proved, depths ranging from 18 to 60 ft. and values running from 2 to 6 per cent tin oxide.

Tasmania

▶ Briseis Consolidated, N.L., Derby, showed a net profit for 1938 of £A26,967, after providing for all charges, including taxation and depreciation. During the year, 722,000 cu.yd. were treated, yielding 544 tons tin oxide (1.68 lb. per cubic yard). Realization was valued at 29.44d. per cubic yard, and working costs totaled 16.15.

▶ Mount Lyell Mining & Railway Company, Ltd., Queenstown, treated 556,107 tons of ore during the half year to March 31, producing 5,985 tons of cathode copper, compared with 5,819 tons during the preceding six months.

Papua

▶ Cuthbert's Misima Gold Mine, Ltd., Misima Island, recorded a net profit of £A40,601 for the year to Dec. 31, 1938. Ore treated totaled 33,520 tons, returning 9,608 oz. of gold and 20,441 oz. of silver. Ore reserves increased slightly during the year to a total of 194,000 tons proved and 118,000 tons probable, all of which is in the oxidized zone, the sulphides being as yet undeveloped. An increase in treatment capacity is contemplated.

Solomon Islands

▶ Considerable interest is being manifested in reported prospects of lode gold on the island of Guadalcanal, British Solomon Islands Protectorate, and several companies have been formed to take up areas in the vicinity. T. R. Victor, mining engineer and a director of Australian Gold Development, N.L., left early in May for the islands to make an examination.

NEW BOOKS

MINING YEAR BOOK, 1939. (Fifty-third annual issue). *Compiled by Walter E. Skinner and sold by him at 15 Dowgate Hill, Cannon St., London, E.C. 4, England. Pp. 1032. Price, 20s. net, 20s.6d. post-free abroad.*

THIS useful volume contains particulars of 1,268 important mining companies of the world, alphabetically arranged; also lists of directors (3,700) and mining and consulting engineers (1,022), with their addresses and business connections. Useful sketch maps, 23 in number, are inserted at intervals. Every individual notice, it is claimed, is revised annually.

PRINCIPLES OF METALLOGRAPHIC LABORATORY PRACTICE. *By George L. Kehl, Lehigh University. McGraw Hill Book Company, Inc. Pp. 359. Price $3.50.*

THE AUTHOR has attempted to present in one book material scattered throughout literature and to do so clearly and concisely. In the first four chapters (100 pages) polishing, etching, microscopy, and photomicrography are covered in logical sequence. A definite weakness of this part is the use of poor illustrative photomicrographs. Maybe we are overcritical, but after the beautiful reproductions given in J. R. Vilella's "Metallographic Technique for Steel," one is inclined to demand a high standard in reproducing photomicrographs, especially in a book that is illustrating good and bad technique.

The chapter on macroscopic examination of metals is somewhat sketchy and is much weakened by inferior reproductions. Chapters on hardness testing, special metallurgical tests, pyrometry, and thermal analysis are well handled. Instead of a chapter on hardness testing, however, it would perhaps have been desirable to have included one on mechanical testing in general, inasmuch as it is difficult to find this subject treated as a whole by men familiar with the metallurgical viewpoint. Aside from this, the book is a fairly complete survey of metallographic practice and will undoubtedly be found an excellent reference work by many. We feel that the first part of the work, on polishing, etching, and photomicrography, will be of particular help to anyone beginning laboratory work in metallography.

BERNARD R. QUENEAU

PUBLIC RELATIONS FOR BUSINESS. *By Milton Wright. Whittlesey House, McGraw-Hill Book Company, New York and London. Pp. 346. Price $3.*

CONSIDERING the attention that has been focused on the subject of public relations during the past year, Mr. Wright's readable book brings definition and clarity to a topic too often shrouded in mystery. He lifts it out of the abstract and presents it in concrete form ready for executive comprehension and action. He makes his points with case studies, and emphasizes his thesis with examples from everyday business experience. He explodes popular fallacies about business and industry without whitewashing them, and shows the reason for certain trends in "the spirit of the times." Chapter headings reveal the development of the author's theme: Industry's New Rôle, Reorganizing for Good Will, Telling the Public, Your Employees as Allies, Winning the Consumer, Protecting the Stockholder, Your Friend the Competitor, Business and the Government, Especially for the Little Fellows. Principles and policies are laid down at the end of each chapter so that the reader has a clear and concise summary of each aspect of the subject. The treatment is, above all, practical and simple. In short here is a manual that executives cannot afford to overlook.

MINE SURVEYING. In Italian, the title being "Topografia di Miniera." *By Tullio Seguiti, engineer of the Corpo Reale delle Miniere. Published by Ulrico Hoepli, Milan, Italy. Pp. 391, 310 illustrations and numerous tables.*

THE contents of this book, indicated by the chapter headings, are: 1, Introduction. 2, Errors and their compensation. 3, Accessory equipment, such as lights, targets, spads, etc. 4, Measurement of length. 5, Measurement of angles. 6, Polygons and their solution (or closing). 7, Triangulation. 8. Magnetic surveying. 9, Instruments and methods for magnetic surveying. 10, Determination of the meridian. 11, Measurement of elevation (leveling, etc.). 12. Complete surveying. 13, Topographic mapping. 14, Mine plans. 15, Underground surveying problems. 16, Measurement of strata. 17, Laying out curves, giving lines, etc. Appendix.

DEUTSCHES BERGBAU JAHRBUCH, 1939. *Published by Verlag Wilhelm Knapp, Halle (Saale), Germany. Pp. 395. Price, foreign, 11.85 Rm.*

THIS volume, which makes its appearance for the 30th consecutive year, is a "yearbook and directory" of German anthracite, brown-coal, potash, and ore-mining industries, as well as of salt works, and petroleum and asphalt properties. It is excellently arranged, the various subdivisions being distinctly separated from one another by title-pages and side-index tabs. In addition, an alphabetical index is provided which is similarly divided into the corresponding sections, each tabbed at the top edge to indicate the subdivision to which it refers. Within each section the classification of companies is well indicated by the use of boldface type, graded in size to indicate the subordination of parts.

For each company, the descriptive data given cover essentials, including such facts as production figures and number of employees for 1937 and 1938. The advertising carried is also indexed as to type of equipment, thus affording a guide to buyers.

MINE EXAMINATION AND VALUATION. Second Edition. *By Charles H. Baxter and Roland D. Parks. Published by Michigan College of Mining and Technology, Houghton, Mich. Pp. 331, plus supplement. Price $3.50.*

IN THE second edition, which follows the first by six years, the authors have on the whole made rather extensive changes in their book, though leaving it fundamentally the same. In part these changes consist of the rewriting of certain portions, particularly those dealing with sampling and interest rates, and in rearranging others to improve the sequence, especially in Part II, where also the occasional insertion of new material helps the exposition. Here should be noted the addition of seventeen pages, not in the earlier edition, on development and equipment charges and the valuation of an undeveloped property. The valuation tables in Part III have been rendered more useful by broadening the range of interest rates. Two new tables have been added.

Revision has improved the book, meritorious as it was before. Intended originally as the basis for the course in the subject of the title at the College at Houghton, it will be useful to all examining engineers.

▼

PUBLICATIONS

RECEIVED

Surveying. Geodezja (Miernictwo). By Prof. Kasper Weigal. (In Polish). Mianowski Institute for the Encouragement of Scientific Work. Warsaw Pp. 468.

The Making and Using of Index Numbers. By W. C. Mitchell. (Reprint of Part 1 of Bulletin 284). Bulletin 656. Bureau of Labor Statistics, U. S. Department of Labor. Sold by Superintendent of Documents, Washington, D. C. Pp. 114. Price 20c.

Gold Coast Colony. Report of Geological Survey Department, 1937-1938. Sold by Government Printing Department, Accra, Gold Coast. Pp. 29. Price 2s.

British Guiana. Geology of the Superficial Coastal Deposits. By D. R. Grantham and R. F. Noel-Paton. Bulletin 11. Geological Survey, Georgetown, Demarara. Pp. 122 and maps. Price $1 (local currency).

Asbestos Industry in Canada 1937. Dominion Bureau of Statistics, Ottawa. Pp. 13. Price 15c.

Tanganyika Territory. Annual Report, 1937, of the Director of the Geological Division, Department of Lands and Mines, Dodoma (post office). Pp. 31. Price 1s. 6d. Also Short Paper No. 19, entitled "The Geology of the Country Around Mpwapwa." By B. N. Temperley. Pp. 61, plus maps. Price 4s. Also Short Paper No. 18, entitled "The Geology of the North Ilunga Area." By A. C. Skerl and F. Oates. Pp. 38, plus map. Price 3s. Also Short Paper No. 20, on "The Geology of Parts of the Tabora, Kigoma, and Ufipa Districts, Northwest Lake Rukwa." By G. M. Stockley. Pp. 35, plus map. Price 3s.

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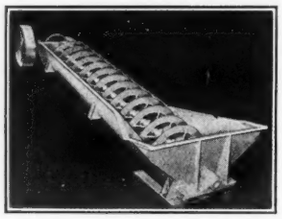

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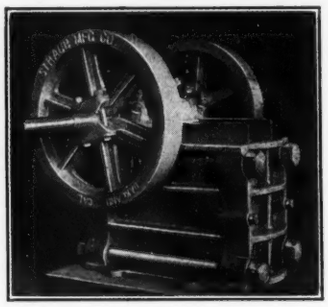

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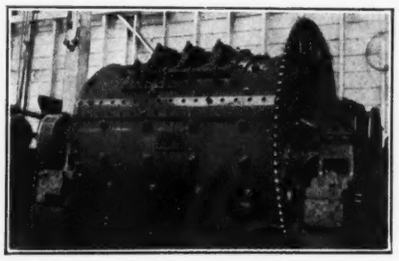

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WRITE FOR CATALOG NO. 37

NAYLOR PIPE COMPANY
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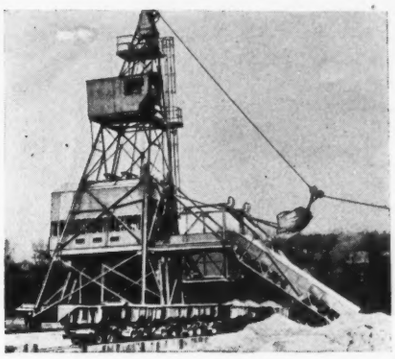
EQUIPMENT NEWS

Tower Excavator

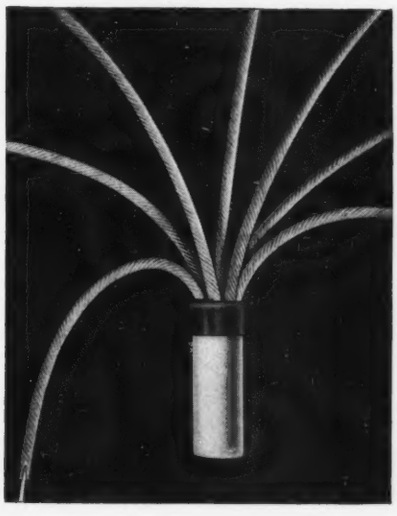
A 4-Cu.-yd. tower excavator is announced by Sauerman Bros., Inc., 484 South Clinton St., Chicago. The new machine is furnished with a 4-cu.yd. Crescent scraper bucket and carries on the head-tower a Sauerman special two-drum hoist powered with either a 170-hp. gasoline engine or a 150-hp. electric motor. The head-tower usually is



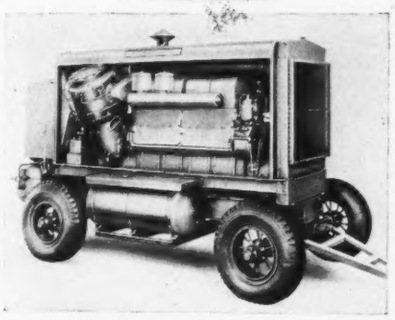
mounted on car wheels and the tail-tower on crawlers. A steel ramp, hinged to the front of the head-tower, permits the scraper bucket to drag its loads of material up to a small hopper, which in turn discharges the material into cars or onto a belt or other conveyor. The ramp is omitted when the machine is used for building dikes or dams. As an example of the machine's handling capacity, the manufacturer states that in ordinary earth excavation with the scraper bucket operating on an average haul of 200 ft., the hourly output is 170 cu.yd. This output increases, of course, if the haul is shortened, and decreases if the haul is extended.

New Fuse Lighter

AN IMPROVEMENT in blasting technique is offered by the Ensign-Bickford company, Simsbury, Conn., in its Master



fuse-lighter, consisting of a tough, waterproofed fiber cartridge shell in the base of which is an ignition compound. The shell is topped with a rubber cap, the center of which is so designed that when the fuse is pressed against the thin portion, it is easily punctured, allowing the fuse to be seated against the ignition compound. It serves also to hold the fuse in place. Each lighter is said to hold seven fuses, six that lead to charges in the bore holes; the seventh is a pilot fuse. The manufacturer recommends this fuse lighter particularly for use in mines where rotation firing is used. Holes are loaded in the usual manner with the fuse extended far enough so as to form groups of two to six holes with each Master lighter. This fuse is then trimmed for proper rotation of shots. When more than one Master lighter is used at a face, the pilot fuse in each is trimmed for proper rotation of lighters. It is claimed that this device permits greater safety and efficiency. In wet work the lighter can be turned up so as to prevent dripping water from running down the fuse or wetting the powder in the end of the fuse.



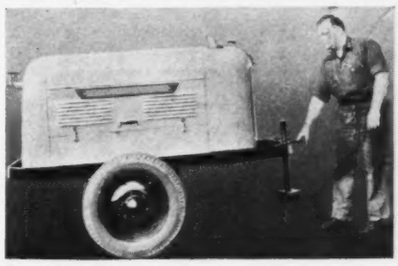
Having a capacity of 700 cu.ft. per minute, this new diesel driven portable compressor of the Chicago Pneumatic Tool Company, 6 East 44 St., New York, N. Y., is said to offer greater fuel economy, lower attendance cost, and lower maintenance expense

Vibrating Screen

ALLIS - CHALMERS Manufacturing Company, Milwaukee. Wis., in connection with its line of vibrating screens, has added a new type of low-head screen especially designed for helping keep the fine-mesh cloth clean. Referred to as the company's Sta-Kleen screen, it is claimed to be unusually well adapted to the screening of moist materials such as fine crushed stone, ore, or other materials that usually cause "blinding." Several inches below the screen cloth is a sub-deck made of perforated metal with relatively large holes. The space between this additional deck and the screen cloth is divided into compartments each containing a special rubber ball. When the screen is in motion the rapid bouncing of these balls within their respective spaces sets up a secondary vibration in the screen cloth. Blinding is thus said to be reduced to a minimum without much wear on the cloth.

Portable Compressors

THE SULLIVAN Machinery Company, Michigan City, Ind., announces the addition of a completely new line of portable air compressors known as the "Zeph-Air." The new line is said to feature compact construction, self-starters, and refinement of other details to



provide extreme mobility and ease of operation. Two sizes are available with capacities of 60 and 85 cu.ft. per minute, respectively, of delivered air. Although these compressors have capacity to operate concrete breakers and rock drills, they are so small and compact that the two-wheel mountings can be towed by a pleasure car and the skid-mounted models can be mounted in the body of standard pick-up trucks.

A New Brunton Accessory

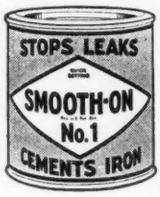
THE ORIGINAL MAKERS of the Brunton pocket transit, William Ainsworth & Sons, Inc., of Denver, announce their Universal alidade as a new Brunton accessory. This alidade has been specially devised to facilitate the taking of bearings in steep raises, winzes, and stopes. Its range is from zenith to nadir. Consisting of a hinged alidade mounted above a circular plate, it is made to fit over the glass of a Brunton and is easily rotatable. The circular plate has two pointers for readings on the graduated circle of the Brunton. One is aligned with the alidade and the other at quadrature with it. In use, the Brunton, which must be mounted on its tripod, is oriented with the compass, and the sight taken with the alidade. The reading of the aligned pointer is then taken and from it the bearing of the sight is derived. If the mirror or sight vein of the Brunton interferes with the taking of the sight, the Brunton is reoriented with the "E" or "W" of the scale to the north of the needle and the reading taken from the quadrant pointer. A Brunton, on its tripod and equipped with this alidade, can also be used as a light surveyor's transit. It is then independent of its compass and is particularly serviceable where there are magnetic disturbances, or where greater precision is desired.

Air Trap

THE ARMSTRONG Machine Works, 871 Maple St., Three Rivers, Mich., announce an automatic "snap-action" mechanical trap for draining water from compressed-air lines, tanks, separators, and aftercoolers. The principal advantages claimed for the device are immunity to ordinary dirt troubles, ability to discharge water without any loss of air, positive opening and closing of discharge

PRACTICAL STEPS to BETTER REPAIRS

1. *Study the SMOOTH-ON HANDBOOK.*



2. *Keep a small can of Smooth-On No. 1 in your repair kit ready for emergency.*

MAINTAINING good power plant operating conditions involves a continual battle. With the added complications imposed by modern high speeds, high pressures, extreme temperature variations, limit forcing of capacities, etc., repairs have increased in volume, and the necessity for making them better has become more urgent.

No plant can be free from routine and emergency repairs, but those to stop leaks, patch cracks under pressure, reinforce corrosion-weakened or punctured metal, and tighten loose parts involve surprisingly little effort, time loss and expense if made with Smooth-On No. 1.

This material, requiring no use of heat or special tools, hardens into solid metal, and when judiciously applied, its adhesive and expansion properties permit of a seal that permanently defies pressure and temperature variation, vibration and ordinarily destructive chemical action. The cost for the Smooth-On is almost nil and the frequent complete avoidance of parts renewal, and disassembling and reassembling, make savings that are possible in no other way and in an emergency may save hundreds of dollars.

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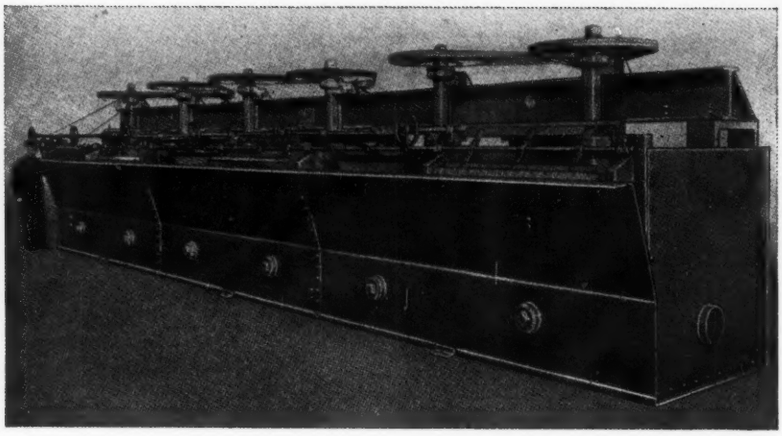
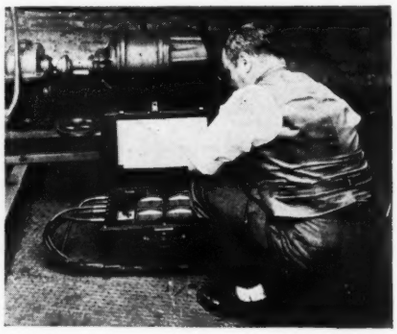
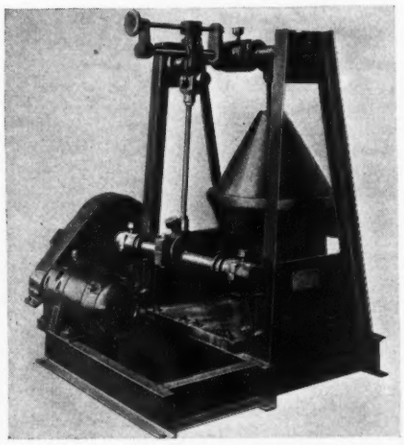


Rated with a capacity of 3,000 tons a day, the Denver Equipment Company, Denver, Colo., announces this No. 30 Denver "Sub-A" (Fahrenwald) Flotation cell as the world's largest

valve, and freedom from need for priming. The capacity claimed by the maker is 1,400 lb. of water per hour at 125-lb. pressure and 1,000 lb. per hour at 250-lb. pressure.



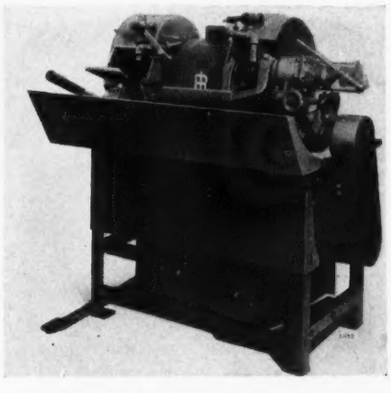
Handy sockets for plugging in test instruments are announced by Westinghouse Electric & Manufacturing Company, Pittsburgh. The operator is plugging the test jack into the socket while equipment or motor is in operation. Tests may be made constantly or as often as needed



The length of stroke or pump capacity may be varied in this improved diaphragm pump manufactured by the Hardinge Company, Inc., York, Pa.

Heavy-Duty Cooling Fan

SOUTH BEND Air Products, Inc., have recently placed on the market a new heavy-duty fan known as the Aerospot, said to be particularly adapted to cooling service in large plants. This model has been adopted for use in some large industrial mills, foundries, and metal-working plants. The fan features unbreakable forged aluminum alloy blades; each pair of blades is one continuous forging. Scientific blades design is said to provide uniform air velocity across entire blade area. The fans are available in capacities from 3,000 c.f.m. to 26,500 c.f.m.



Ingersoll-Rand Company, Phillipsburg, N. J., has announced a new Jackbit grinder known as the J-5. The machine is operated by one man and is said to be capable of increasing production to 60 average hard bits or 100 average annealed bits per hour.

Snap-Action Limit Switch

DESIGNED FOR USE on machine tools, conveyors, and other automatic equipment, a small, snap-action limit switch (CR9440-D2) recently announced by the General Electric Company, Schenectady, N. Y., is said to have the advantage of being so constructed that it can be easily mounted for operation in practically any position. The new device was developed to meet a need among machine designers and users for an inex-

pensive limit switch that not only would be small in size but which would also operate slowly without contact burning and be proof against oil and dirt around a machine.

Return Idler

ROBINS CONVEYING BELT COMPANY, New York, N. Y., announces a return idler for use on any conveyor belt which handles abrasive, corrosive, damp, or somewhat sticky material. It is constructed of a steel-tube shaft on which are mounted a series of tough and resilient rubber disks, spaced about 6 in. apart except at the ends, where the last two are about 3 in. apart.

The resilient and flexible rubber disks and the open construction with the belt supported at only a few points, instead of its whole width, are said to make this a self-cleaning idler. and it is said conveyed material cannot build up.

A light-weight, compact, small-type hoist operating on ordinary light circuit and available in four capacities from 250 to 1,000 lb. is announced by the Chisholm-Moore Hoist Corporation, 294 Fremont Ave., Tonawanda, N. Y.

Self-Regulating Battery Charger

A NEW completely automatic and self-regulating electronic battery charger called the Phano-Charger has been developed by the General Electric Company, Schenectady, N. Y., for charging and maintaining storage batteries used in substations, and other places for standby service, control power, and emergency lighting. By using industrial-type metal phanotron rectifier tubes, moving parts are said to be eliminated, thus assuring long life for the equipment and practically silent operation. The chargers are available in three sizes: 4.5 amp. and 12.5 amp. to operate from a single-phase power supply, and 25 amp. to operate from a three-phase ac. supply. The unit is readily adjustable over a wide voltage range, making it possible to trickle-charge a fully charged battery. The voltage characteristic of the Phano-Charger is exceptionally flat from no load to full load and then breaks abruptly into a relatively constant-current characteristic. Voltage regulation is maintained within plus or minus 1

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COMPOUND FUNNEL CLASSIFIER—Gold trap for coarse gold. Preparation of ore pulps for table concentration. *Bulletin 23.*

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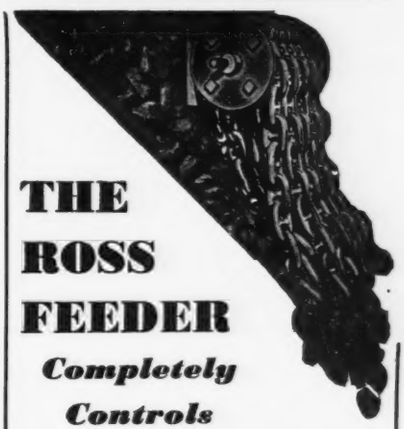

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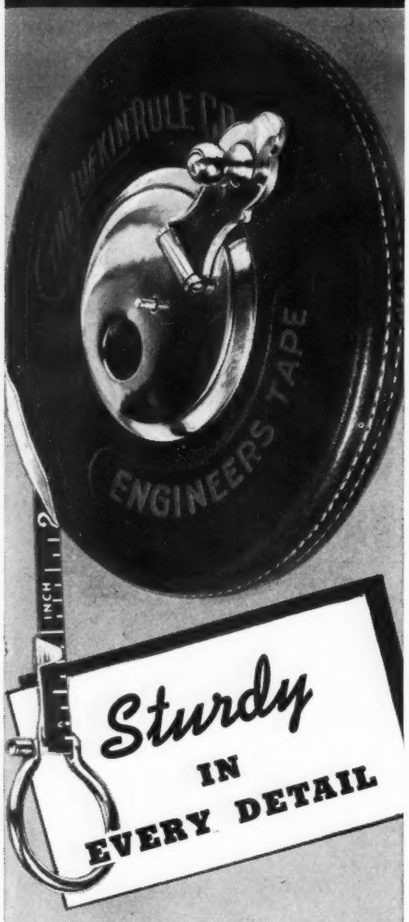

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per cent from no load to full load and for a variation in the ac. line voltage of plus or minus 5 per cent. A saturable reactor is said to provide a means for close regulation, and inherent protection for the tubes, regardless of momentary or sustained battery loads.

A new, low-resistance twin filter respirator having Bureau of Mines approval, No. 2127, for use in protection against Type A and lead dusts, is announced by the Willson Products, Inc., 260 Thorn St., Reading, Pa.

INDUSTRIAL NOTES

Frank W. Klatt has returned to the W. W. Sly Mfg. Company, Cleveland, Ohio, as general manager, a position that he formerly occupied from 1920 to 1927.

Marion Steam Shovel Company, Marion, Ohio, recently appointed J. F. Weis, formerly assistant electrical engineer, as special sales representative traveling out of the home office.

Naylor Pipe Company, of Chicago, announces the appointment of Gene McIntyre, 727 West Seventh, Los Angeles, as the Naylor Lockseam Spiralweld pipe representative in California and Arizona.

Roots-Connersville Blower Corporation has moved its Chicago office from Room 814, 140 South Dearborn St., to Room 1027, People's Gas Building, 122 South Michigan Ave. William Townsend is district manager and James T. Sutliff is sales engineer.

Eugene F. Bohach, with headquarters at 163 East Walton Place, Chicago, Ill. has been appointed mid-Western representative of the Greene Tweed & Company following the resignation of V. B. Nickerson.

Buell Engineering Company, of New York, and the **B. F. Sturtevant Company,** of Hyde Park, Boston, have completed arrangements whereby the Sturtevant field organization will parallel the work of the Buell service staff, thus greatly increasing service facilities on Buell dust and fly ash collectors throughout the country.

Bertrand Robinson was recently appointed to the engineering and sales staff of Hardinge Company, Inc. He will represent the company in eastern Canada, with headquarters in Toronto.

Expansion among iron and steel producers and by mining operators has led the Meehanite Metal Corporation, Pittsburgh, Pa., to establish a subsidiary company known as the South African Meehanite Metal Company (Pty.), Ltd., Johannesburg, South Africa.

The Seventeenth Exposition of Chemical Industries will be held this year at Grand Central Palace, New York City, during the week of Dec. 4 to 9.

BULLETINS

Jackbit Grinder. Ingersoll-Rand Co., Phillipsburg, N. J. Bulletin 2534 describes and illustrates the manufacturer's new J-5 Jackbit grinder. Pp. 8. **Air and Gas Receivers.** Folder 9292 describes 23 standard air and gas receivers made by the company. **"PRE" Direct-Connected Synchronous Motor-Driven Compressors.** Bulletin 3426-1 describes the improved redesigned compressor units from 700 to 3,000 hp. Pp. 11. **Drill Steel Sharpener.** Bulletin 2176A describes and illustrates the manufacturer's line of rock-drill sharpeners and oil furnaces. Pp. 4.

Small Mill Data. Denver Equipment Co., Denver, Colo. Bulletin S-O-B describes all important equipment necessary for small ore-treating plants. Two blueprint layouts are shown. Pp. 4.

Deep-well Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin W-321-M3A describes the Jetflo deep-well pumps for domestic and industrial uses. Pp. 5. **Portable Compressors.** Bulletin H-850-B56 describes and illustrates five sizes of the manufacturer's portable air compressors. Pp. 5 Bulletin H-850-B56 describes four sizes of diesel-driven portable compressors. Pp. 5. Bulletin L-611-B8 describes and illustrates feather-valve compressors, motor and steam driven. Pp. 8. **Diesel Engines.** Bulletin S-500-B5E describes outstanding features of Type B vertical four-cycle diesel engines. Pp. 8. **Vertical Turbine Pumps.** Bulletin W-450-B25A describes features of pumps for mine dewatering and cofferdam service. Pp. 3.

General Catalog. Jeffrey Manufacturing Co., Columbus, Ohio. Catalog 87 contains data on the manufacturer's line of conveyors, elevators, chains, sprockets, transmission machinery, vibrating feeders, screens, coolers, dryers, crushers, and pulverizers. Tabular matter, engineering data, and many illustrations are features of the catalog. Pp. 960.

Switchboards. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Descriptive data 31-132 contains information on small-capacity switchboard panels. Department 7-N-20. Pp. 11. **Outdoor Circuit Breakers.** Descriptive data 33-745 contains information on multiple-tank circuit breakers. Pp. 7. **Small A-C Welders.** Known as Midget Marvel Flexarc welders are described in data sheet 26-320.

Wood Preservation. Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin 1834 is an informative and well-illustrated publication on the subject of wood preservation. Pp. 31. **Vari-Pitch Sheave.** Bulletin 1261-B describes and illustrates Vari-Pitch Texrope sheaves for use in occasional changes of speed. Pp. 15. **Feeders, Conveyors, and Screens.** Bulletin 1833-A describes the manufacturer's complete line of Utah electro-magnetic feeders, conveyors, and screens which operate without rotating or sliding parts. Pp. 11.

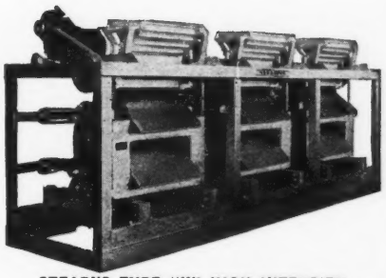
Wire Rope Corrosion. Macwhyte Co., Kenosha, Wis. The manufacturer offers this leaflet as the first in a series of informative bulletins for wire-rope users. Pp. 1.

Compression Indicator. Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa. Bulletin 278 describes and illustrates the Premac indicator to determine compression and firing pressures of diesel engines. Pp. 7.

Scrapers. Sauerman Bros., Inc., 438 South Clinton St., Chicago, Ill. Bulletin 151 describes the method of reclaiming materials from storage piles by use of a drag scraper operating in a tunnel. Pp. 11.

Crushers. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin 1469-E describes and illustrates the Newhouse type high-capacity reduction crusher. Dimension and capacity tables are included. Pp. 15.

Placer Mining Dredges. Yuba Mfg. Co., 351 California St., San Francisco, Calif. The 1939 catalog is a handsome brochure with many illustrations of the manufacturer's various types of placer mining dredges used in various parts of the world. Pp. 30.



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Head and Eye Protection. Chicago Eye Shield Co., 2300 Warren Blvd., Chicago, Ill. 24th catalog edition describes and profusely illustrates various types of head and eye protection for workmen in various industries.

Nickel and Nickel-Base Alloys. International Nickel Co., Inc., 67 Wall St., New York, N. Y. Bulletin T-13 is the enlarged edition and has many changes from the preceding issue. Pp. 31.

Speed Reducers. Stephens-Adamson Mfg. Co., Aurora, Ill. Catalog 7838 illustrates and contains engineering data on the company's SA10 speed reducers. Pp. 8.

Mounted Goggles. Mine Safety Appliances Co., Pittsburgh, Pa. Leaflet CE-7 describes the manufacturer's Speedframe that raise or lower goggles on wearer by a slight nod of the head. Pp. 1. Bulletin CE-8 describes and illustrates the manufacturer's goggles. Pp.

Controlled Torque Coupling. Falk Corp., Milwaukee, Wis. Bulletin 4630 describes the manufacturer's new torque coupling. Pp. 4.

Pump Data Book. Economy Pumps, Inc., Hamilton, Ohio. This pocket-size handbook describes the wide field of pumping applications for general industrial requirements. The first half of the book describes pumps, motors, and starters, and gives installation data. The second half contains tables, diagrams, pipe layouts, and engineering data. Pp. 233.

Electric Hoist. Yale & Towne Mfg. Co., Philadelphia, Pa. Folder P-388 describes and illustrates features of the manufacturer's air-cooled Cable King electric hoist with capacity from ¼ to 6 tons. Pp. 5.

Water Wheel Generators. Allis Chalmers Mfg. Co., Milwaukee, Wis. Leaflet 235 illustrates generator built by the manufacturer for this use. Pp. 15. **Direct-Current Motors and Generators.** Leaflet 2183-A describes construction details of motors. Pp. 4. **Explosion-Proof Motors.** Leaflet 2125-C describes motor that gives protection in explosive fume-laden atmospheres. Pp. 4. **Equipment for Metallic, Non-Metallic and Associated Industries.** Bulletin 161 illustrates and describes types of production machinery applicable to the mining and related industries such as compressors, blowers, and electrical and pumping equipment. Pp. 96. **Squirrel-Cage Induction Motors.** Bulletin 1195 describes and illustrates construction details of squirrel-cage induction motors. Pp. 8.

Tractors. Caterpillar Tractor Co., Peoria, Ill. Form 5330 describes and illustrates features of the 61-hp. diesel D7 tractor. Pp. 31.

Mine Locomotive Gearing. General Electric Co., Schenectady, N. Y. Leaflet 2879 describes features of special gearing for mine locomotives. Pp. 1. **Metal enclosed Switchboard.** Bulletin GEA--2872 is entitled "What Every Plant Operator Should Know About Metal-inclosed Switchgear." Pp. 23. **Magnetic Motor Starter.** GEA-2964 illustrates features of the new D-51 starter. Pp. 5. **Sealed Axle Bearings.** Leaflet GEA-2641 describes the manufacturer's improved axle bearings for mine locomotive motors. Pp. 2. **Vacuum-Tube Time-Delay Relay** Leaflet GEA-2902-A describes timer for processing, cycling, sequencing, limiting, and delaying. Pp. 2. **Capacitor Motors.** Bulletin 2915 describes and illustrates features of general-purpose Type KC capacitor motor ⅛ to ¾ hp. Pp. 7. **Electrode Quantities.** Booklet GES-1749 is entitled "Handy Estimator for Determining Arc-Welding." Pp. 8.

Diaphragm Pump. Denver Equipment Co. 1400 Seventeenth St., Denver, Colo. Bulletin 39P8B1 describes and illustrates features of the manufacturer's 5- and 6-in. diaphragm pump. Pp. 3.

Flotation Machine. Morse Bros. Machinery Co., Denver, Colo. Bulletin 82 describes and illustrates new features of the Morse- "Weinig" flotation machines. Pp. 4. **Laboratory Machinery.** Bulletin A-9 illustrates equipment for ore-dressing laboratories. Pp. 2. **Ore-Dressing Machinery.** Bulletin B-9 describes equipment for mills from 25- to 125-ton capacity. Pp. 4.

Hydrometers. Wm. Hiergesell & Sons, 295 Pearl St., New York, N. Y. Bulletin 205 describes features of various types of hydrometers of the manufacturer.

Automatic Proportioning and Sampling. Proportioneers, Inc., 55 Codding St., Providence, R. I. Bulletin TOU-3 describes and illustrates various types of equipment by the manufacturer for treating, feeding, diluting, blending, proportioning, and sampling. Installation diagrams and capacity charts are given. Pp. 19.

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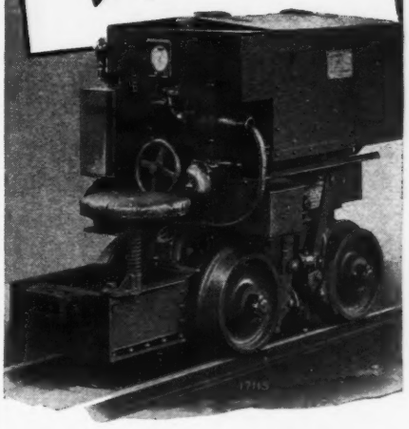

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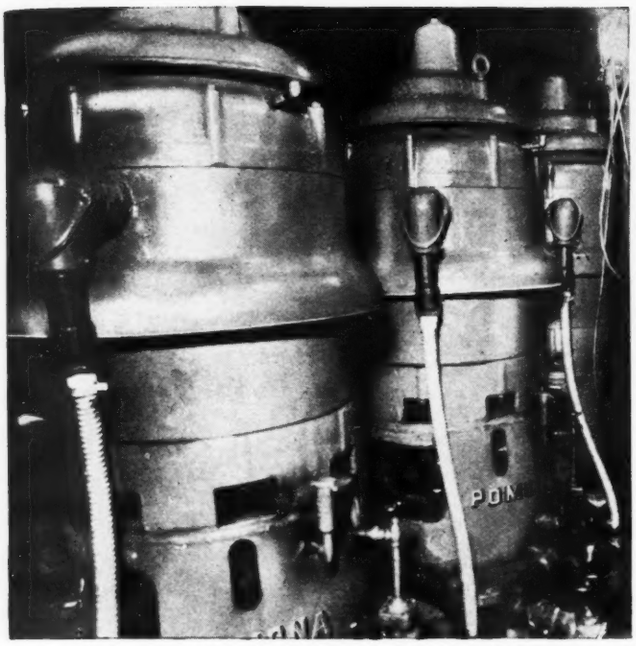

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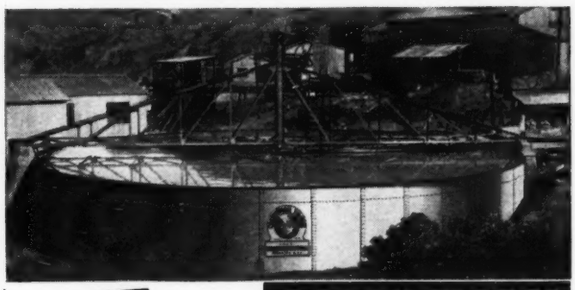

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